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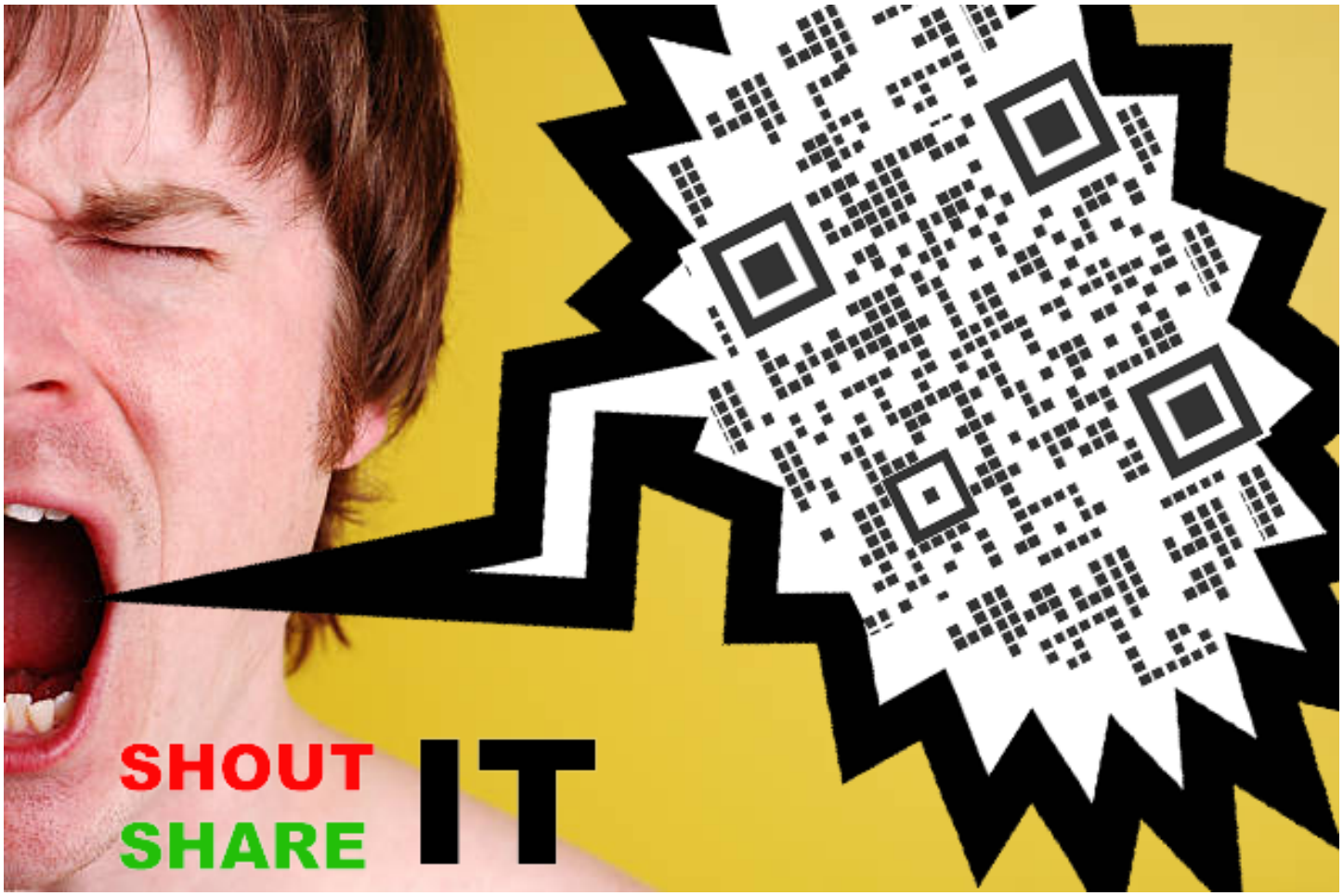
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UNITED STATES DEPARTMENT OF AGRICULTURE

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CARL L. ALSBERG, Chief

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A STUDY OF THE PREPARATION OF FROZEN AND DRIED EGGS IN THE PRODUCING SECTION.

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CONTENTS.

	Page.
Introduction	1
Review of the egg-breaking houses as seen in 1911	2
Plan for the experimental work of 1912	3
General statement of the investigation and the results	4
Classes of eggs presenting special problems	9
Comparative study in two houses on eggs before and after desiccation	15
Comparison of the liquid product from three houses in 1912	16
General summary of laboratory results on commercial samples, 1912	18
Conclusions	20
Glossary	21
Appendix	22
Details of experiments in each cooperating house, 1911 and 1912	22
Tabulated results	64

INTRODUCTION.

The origin of the investigation of the preparation of frozen and dried eggs has been set forth in Circular 98 [2] of the Bureau of Chemistry. The need, from an economic viewpoint as well as that of wholesomeness, for the conservation of certain eggs out of their shells is also discussed in the circular cited. In the pursuance of the plan of work therein outlined, a study has been made of the various types of eggs going to the egg-breaking establishments in the egg-producing section. The results of this part of the investigation are given in Bulletin 51 of the Department of Agriculture.

The next step in logical sequence would be a study of the conditions prevailing in egg-breaking houses and the quality of the product sent into commerce. In the preliminary survey of the problem, as given in Circular 98, and the general observations made to determine methods of procedure and points of attack, a policy of cooperative work with the industry was outlined. These tentative plans were ultimately followed, and the information gained by uniting the observation and experimentation in the packing house with the analytical data of the laboratory is collected in the present publication.

The body of the bulletin gives a general statement of the work done and the findings which should be of interest to the general egg industry, but more particularly to manufacturers of frozen and dried products and bakers who use these products. In the appendix are given details of the investigation of use to those who have the actual management of egg-breaking plants and to chemists and bacteriologists engaged in food investigations.

[1] The assistance of J. M. Johnson and H. W. Houghton in the making of the chemical analyses during the active season of 1911 is hereby acknowledged.

[2] Practical Suggestions for the Preparation of Frozen and Dried Eggs, M. E. Pennington, Food Research Laboratory, Bureau of Chemistry, U. S. Department of Agriculture.

A part of the problem facing the investigators was the conservation of eggs in the form of a wholesome, good-quality foodstuff. Waste due to spoilage begins on the farm and increases with every step on the complicated road to the consumer. The sooner, therefore, eggs unsuited for marketing in the shell can be removed from the shell and rendered stable the more of them can be saved and the better, as a rule, will be the quality of the product. It is scarcely possible that a system of handling and distributing eggs ever will reach such perfection that the consuming centers will fail to receive some eggs not marketable in the shell. Large centers will receive so many such that it is eminently desirable that those good for food purposes be saved. But, from the economic point of view, the industry should be primarily a producing-region industry, that the expense of deterioration, transportation, and handling in the market be saved. Of first importance, therefore, is the study of breakage conditions in the producing country.

This report is based on observations made in establishments scattered between northwestern Iowa and central Kansas. The work began in the spring of 1911 and was maintained during the egg-breaking season; that is, until early September. It was continued, also, throughout the season of 1912 in the same territory.

Through the cooperation of the industry it was possible to visit and become intimately acquainted with the routine methods of many establishments, although the experimental work could be carried on with comparatively few, because of the distance between the houses and the laboratory and the size of the force of investigators required. During the season of 1911 five separate plants were studied in detail, and in 1912 three were kept under observation.

An effort was made to keep the various establishments cooperating in touch with the results obtained that improvement in the quality of the product might follow quickly upon the heels of knowledge gained. So promptly did the industry avail itself of these suggestions that the houses were constantly changing the material used, the apparatus, and the methods of work. There was, therefore, a continued tendency toward better environment and product, and each visit brought to light new phases to be studied rather than existing conditions to be confirmed by repeated observations. This rapid application of information tended to mar the scientific continuity of laboratory results, but since the object of the work was better frozen and dried eggs for the people the progressive spirit of the cooperators was encouraged, not hindered.

As the principles of cleanliness of apparatus, grading of eggs, discipline of breakers, and other fundamentals of a product of standard quality were unfolded the scope of the work broadened to take in the new problems presented. The industry found it desirable to plan the construction of breaking rooms, wash rooms, candling and receiving rooms, the application of mechanical refrigeration to the work in hand, etc., with the departmental investigators, that the principles of good handling might be fulfilled. Such activities opened a field of work in the study of sanitary surroundings for the preparation of easily infected and readily perishable products. The construction of suitable quarters for such work, therefore, forms an important part of this report.

It is highly desirable when investigating perishable commodities that they be traced from the point of origin to the point of consumption. To do this for frozen and dried eggs involves a study of the effect of long holding—since these products are almost invariably kept to tide over the season of egg scarcity—and their routine usage by the baker while in course of preparation for his products. It will be seen, therefore, that a distinct and important link in the history of the frozen or dried eggs going to the ultimate consumer must be sought outside of the packing house. Such a study in cooperation with the bakers is under way, and will be reported in due time. This report, however, deals with the industry in the packing houses of the West only.

REVIEW OF THE EGG-BREAKING HOUSES AS SEEN IN 1911.

The establishments discussed in the following pages were fair representatives of the best types of egg-breaking plants in existence in the Middle West. The management in every case was more than eager to prepare a good product and tried earnestly to use to advantage all the information then available. A survey of the field of work showed, however, that the principles of such cleanliness as is needed were not known in the industry. The equipment was not adapted to the work to be done, making for neither quality of product nor speed of operation. The rooms were so constructed that more than housewifely cleanliness was impossible, and that was attained only by an undue expenditure of time and labor. The grading by the breakers was in almost all cases a hit-or-miss operation; where a system of grading had been installed it was faulty because of a lack of knowledge of the character of the individual eggs. Such a state of affairs gave a product irregular in quality, which was not only a detriment to the baker but often resulted in the waste of good eggs as well as a utilization of bad eggs. Back of the faulty grading in the breaking room there was a universal lack of

care in the candling room. Many bad eggs that should have been thrown aside by the candler were sent to the breaker, complicating her work, soiling the apparatus and, ultimately, finding their way, to a certain extent, to the food product, because her ideas of economy would not permit her to discard a large percentage of eggs, and therefore, unconsciously, she lowered her standard for food eggs.

Grading eggs, either before the candle or out of the shell, requires close attention, yet there was almost unrestricted talking, laughing, or whistling in both candling and breaking rooms. It was not possible to check the work of the individual candlers or breakers, since identities were promptly lost. Such a condition made for carelessness, as a lack of responsibility always does.

The speed of candling or breaking is a factor which must be considered from two viewpoints. If the workman soldiers or is unnecessarily slow, the cost of the work performed is unnecessarily high; on the other hand, if he works too rapidly he is sure to misgrade or do dirty work. It was, therefore, necessary to make a study of speed that both the quality of the product and the cost of production might be put on a more definite basis.

The investigation at the close of the season of 1911 had resolved itself into the following problems: (1) The construction of suitable rooms for the housing of the industry and of suitable equipment to insure cleanliness; (2) the grading of the eggs by candlers and breakers; (3) the keeping of the product after preparation and its behavior in the bakery; (4) the establishment of a system based on scientific observations by which an employee should do a full day's work that will result in a product of definite and uniform quality. The work of the season of 1912 endeavored to solve these questions. The story of the work along the lines indicated follows.

PLAN FOR THE EXPERIMENTAL WORK OF 1912.

The experiments and observations made in the six houses during the season of 1911 showed that certain forms of construction and equipment and certain methods of operation are necessary for the preparation of clean, wholesome frozen and desiccated eggs. In order to make practical application of this information, arrangements were made to work cooperatively with the management of three of the houses while remodeling their construction and equipment, making observations, and assisting in the organization of methods of operation.

Since the laboratory studies during the season of 1911 represented the product prepared under old conditions, bacteriological and chemical samples were taken in D, E, and F houses which were under observation during 1912. The bacteriological and chemical examinations of the samples were made, as in 1911, in the Omaha Food and Drug Inspection Laboratory. The results of the laboratory studies were applied practically, when possible, to improve the quality of the commercial product and to learn which eggs should be conserved for food purposes and which should not.

REMODELING OF CONSTRUCTION AND EQUIPMENT.

The plans for remodeling the construction and the equipment of the three houses were founded on the following general principles:

1. In order to prevent deterioration of eggs after receipt, the holding room, candling room, and breaking room should be insulated and refrigerated. A temperature of 30° F. to 32° F. should be maintained in the first, 50° F. to 55° F. in the second, and 60° F. to 65° F. in the third. The chilling of the candling and breaking rooms is to prevent the sweating of the eggs after they are removed from the chill room. Since the candlers and breakers spend the entire working day in the candling and breaking rooms, it is necessary that both be ventilated. The breaking room and wash room should be built with nonabsorbent walls and floor and should have an abundant supply of natural light. The washroom should be separate from the breaking room and should have a floor sloping toward a drain.

2. The most important piece of equipment in the candling room is the egg candle. It should be supplied with a strong, white light and with openings from three-fourths to one and one-fourth inches in diameter.

3. The apparatus in the breaking room should be of metal, or of a material permitting of absolute cleanliness. The table should have metal legs and a nonabsorbent top, such as monel metal, zinc, galvanized iron, or glass. The breaking trays should be made of a metal which will not rust. The tray should be constructed with a removable breaking knife, with a support for the cups, so that they will not set in the drip collecting from the knife and so that they will not set directly under the knife. The cups should be transparent, not opaque. The egg mixers, preferably, should be surrounded with brine and so constructed that they will permit of steam sterilization for 20 minutes.

4. The wash room should be supplied with hot and cold water and equipped with sinks and sterilizers.

ORGANIZATION OF METHODS OF OPERATION.

The reorganization of the methods of operation included the work of the candling room, breaking room, and wash room.

1. A plan was made to elaborate a system of overinspection in the candling room, to check the work of individual candlers, to recover good eggs thrown out in rejects, and to keep bad eggs which can be detected by the candle from being passed as good.

2. The organization of the work in the breaking room included rules for the proper manipulation of the egg during breaking, for methods of grading, for changing apparatus after breaking a bad egg, for behavior of breaker, and for cleaning the room and its equipment.

3. A routine was established in the wash room whereby the thorough washing and sterilization of all apparatus coming in contact with food egg was insured. Particular attention was given to the arrangement of the equipment of the room to save time and labor.

COORDINATION OF FIELD AND LABORATORY WORK.

From 40 to 50 laboratory samples were taken each week of the various types of eggs occurring throughout the egg-breaking season and of the commercial product during the different stages of its preparation. In some cases large subsamples were taken for later study in bakeries.

The routine bacteriological examination included the determination of the total number of organisms present, the total number of organisms producing gas in lactose bile, and, in some cases, the isolation and identification of members of the *Bacillus coli* group; the routine chemical analyses involved the determination of moisture and the amount of ammoniacal nitrogen by the Folin method. For further details of technic see pages 74 to 77 in U. S. Department of Agriculture Bulletin 51.

Regular visits of five to six days' duration, beginning on April 22 and ending on September 17, 1912, were made on successive weeks to D, E, and F houses. The observations made in the packing house on the quality of the breaking stock, on the efficiency of the grading in the candling and breaking rooms, and on the sanitary precautions enforced in the breaking room and wash room were correlated from time to time with the laboratory data. This information was then utilized as a basis for new or continued work on succeeding visits to the three houses.

PUBLICATION OF RESULTS OF THE INVESTIGATION.

The data obtained from the compilation of the descriptions and laboratory findings of the samples prepared from the various types of eggs occurring throughout the egg-breaking season have been published in Bulletin 51 of the U. S. Department of Agriculture. Upon these data are based the principles of the grading of the eggs used by the breakers and the determination of their fitness or unfitness for human food.

The details of the practical application of the principles of construction and equipment, the observations in the packing house, the organization of candling room, breaking room, and wash room, and the laboratory findings in samples of the commercial product are correlated, discussed, and summarized in the following pages of this report.

The results of the study of samples taken in the field and followed through the bakery, together with a detailed description of equipment, with illustrations, and a discussion of scientific management as applied to the preparation of canned eggs will be given in later publications.

GENERAL STATEMENT OF THE INVESTIGATION AND THE RESULTS.

The frozen-egg industry, hardly 15 years old, is permanent, because it has developed as the direct result of an economic need. Many eggs, such as cracked, small, dirty, shrunken, and slightly heated eggs, commercially termed seconds, reach the first concentrating center in a wholesome condition, but if shipped in the shell to a distant consuming center they would markedly decompose and be entirely unfit for food purposes. The new industry believed that cracked eggs and seconds could be conserved by freezing out of the shell, and the baker thereby supplied with wholesome eggs at a reasonable price during the whole year.

As was to be expected, the new industry had to face many problems. The general public had its usual prejudice against any food coming from cold storage. The industry was ignorant of the general principles of bacterial cleanliness in the commercial preparation of a perishable foodstuff. Unprincipled persons, thinking they could conceal inferiority of low-grade eggs by freezing them en masse, brought the industry into disrepute. Food officials were groping in the dark in their efforts to protect the

public against decomposed eggs. These contending forces were fast making the investment of money in the preparation of frozen and dried eggs a hazardous business proposition.

It was at this time that the Department of Agriculture began its study of the problem. Science had not entered the door of the frozen-egg industry as it had done in allied enterprises—for example, dairying. The investigators had before them the task of laying the groundwork for the scientific preparation of an extremely perishable product.

EVOLUTION IN CONSTRUCTION, EQUIPMENT, AND OPERATIONS.

When this investigation was begun the breaking room in D house was the most modern, and that of E house the most old-fashioned. The former was the only one of five houses under observation in 1911 to have refrigeration in this department. In fact, to this house must be given the credit of being the first to build a model egg-breaking room. It was built entirely of concrete, and the walls were white enameled. The windows were insulated and always closed; therefore, they were fly and dust proof, a condition not found in unchilled rooms. Persons entering the model room were astonished at the whiteness and the abundance of light. In truth, the room had been patterned after a hospital operating room. The practical success of this experiment is shown by the fact that E house built a similar room, but with a capacity about five times as great, for the season of 1912. The egg-breaking room of E house before and after remodeling is shown in Plates IV, V, and VI. The appearance of the breaking room of D and F houses is shown in Plates VII and VIII, figure 2. A freezer with brine-pipe shelves to hold the eggs during freezing is illustrated in Plate XIII, figure 1.

The equipment and the methods followed in the breaking room were for the most part crude. It was in this quarter that a large part of the efforts of the investigators was first centered.

The device used for cracking and holding the eggs during grading was one of the first pieces of apparatus to be attacked. Laboratory studies showed that for the sake of cleanliness the edge on which the eggs were broken should be adjustable and should not be located directly over the cups into which the eggs were dropped; that these containers should be supported by a wire screen or other device to prevent their becoming soiled with drippings of egg; and, thirdly, that glass cups with a capacity of two to three eggs should be used to prevent waste and to facilitate grading. A discussion of these findings with the managements of D, E, and F houses resulted in each perfecting an egg-breaking outfit conforming to the above specifications. F house, however, used metal instead of glass cups. F house also developed a mechanical method for the separation of white and yolk. These changes were begun in 1911 and completed for the season of 1912. Illustrations of breaking outfits of the old type are shown in figures 5 and 7 and also in Plate IX, figure 2. The newly devised egg-breaking trays are shown in Plate IX, figure 3; Plate X, figures 1 and 2; and also figure 6.

The method of cleaning utensils was practically revolutionized as a result of the experiments of the investigators. The washing departments, except in D house, were generally located in a corner of the breaking room. The washing was done in a hit-and-miss fashion. Bacteriological tests showed that even though the utensils were apparently clean to the senses they were excellent seed beds for the bacterial contamination of the product (see Plate I, figures 1 and 2; Plate II, figure 1; and Plate III, figures 1, 2, and 3). That this was the case was shown also by the fact that the bacteria in the product increased as it passed from one container to another in its routine handling in the breaking and drying room. Experiments showed that the only sure method of rendering the utensils bacterially clean was to steam them for 15 to 20 minutes at a temperature of 210° to 212° F. The efficiency of this operation was proved by the fact that the product handled in sterilized utensils contained markedly fewer organisms, other conditions being equal, than did that prepared in containers cleansed by the usual commercial method.

Since these experiments showed that the thorough cleansing and sterilization of utensils afforded a direct means of lowering the numbers of bacteria in the product, and thereby enhancing its stability, the cooperating members of the industry did not require a second bidding to build sanitary well-equipped wash rooms outside of the breaking rooms. In fact, the new wash rooms of E and F houses in 1912 were models of efficiency (see Plates XI and XII).

It was found, also, that the fingers of the breakers, especially after breaking "sweaty," dirty, or bad eggs, were a fertile source of contamination. Actual contact of eggshell and fingers could not be eliminated, neither could a slight wetting of the tips of the thumbs and forefingers with egg be avoided. But both these objectionable practices could be reduced to a minimum by care and skill. Shell contamination was

lessened because the cool air of the chilled breaking rooms prevented the formation of water by condensation. D house and E house in 1912, because of adequate refrigeration, were not troubled with wet-shelled eggs. As would be expected, dirty eggs through contact with the girls' fingers furnished more bacteria to the product, other conditions being equal, than did clean eggs. It was also observed that the breaking of eggs with hands constantly wet with egg not only made the skin tender and oftentimes painfully sore, but also increased the number of bacteria in the product. This condition parallels that obnoxious practice in the dairy industry of milking with wet hands. The handling of the egg with the tips of the fingers, thereby preventing the rest of the hand from becoming wet, and the frequent drying of the ends of the fingers with tissue paper, not only made it possible for the girls to keep their hands in good condition, but also presented a practical means of lessening contamination. The bacteria furnished to the fingers by the outside of the egg were few compared with those derived from the contents of an infected egg, such as a sour egg or egg with a green white. Bacterial examination showed that the thorough washing and drying of hands after breaking a bad egg was the only means of avoiding this contamination. These findings are illustrated in Plate I, figure 4; Plate II, figures 2 and 3; and Plate III, figure 4.

A very common practice was the use of rags, always unsightly, interchangeably for wiping utensils, hands, and the floor. The bacterial examination of water wrung from such cloths revealed hundreds of millions of organisms. These agents, instead of cleaning, spread the dirt. The improvement in the manipulation of the egg, the devising of an outfit suitable for breaking eggs, and the introduction of tissue paper and paper towels for drying hands, practically abolished the use of cloths except for cleaning the tables. These few cloths could readily be laundered, or sterilized, after each day's work, so that they could be kept sweet and clean. These changes eliminated a number of the sources of contamination of the product and did much to improve the appearance of the breaking room as well.

The introduction of pails in place of shipping cases to convey the eggs from the candling to the breaking rooms eliminated considerable dust and litter. The devising of a tray for the holding of leaking eggs made it possible to carry them to the breaking room in a clean condition (see Plate VIII, figure 1; Plate IX, figure 1; and Plate XIII, figure 2.)

As can readily be seen from this discussion, the laboratory findings practically revolutionized the apparatus used and the routine followed in the breaking room. Instead of the haphazard collection of odd pieces of china, glass, and tin, there were evolved machines accurately adapted to the work to be done; and the careless, inconsequent methods of cracking and emptying the shells were replaced by a standardized, definite routine, making for both quality and efficiency.

GRADING THE BREAKING STOCK BY CANDLING.

The classes of eggs principally used for breaking were seconds, cracked, and dirty eggs. It is to be expected that eggs sold for breaking stock would contain a higher percentage of loss than would eggs sold as current receipts, and such, by actual observation, was found to be the case. Comparative data collected in D house showed, as illustrated in Table 1, that from eggs purchased especially for breaking 6.6 per cent of bad eggs were rejected in July and 10.6 per cent in August, whereas from its current receipts only 3.5 per cent were discarded in July and only 3.1 per cent in August.

TABLE 1.—*Condensed candling reports of D house.*

I. CURRENT RECEIPTS.

Month.	Total receipts.	Firsts, seconds, checks.		Bad eggs.	
	Dozen.	*Dozen.*	*Per cent.*	*Dozen.*	*Per cent.*
June	85,083⅜	83,730$\frac{7}{12}$	98.4	1,353⅝	1.6
July	53,109$\frac{5}{12}$	51,265½	96.5	1,843$\frac{7}{12}$	3.5
August	72,040⅔	69,781⅓	96.9	2,259⅓	3.1
Total	210,133⅝	204,777¾	97.4	5,456$\frac{1}{12}$	2.6

II. EGGS SHIPPED TO D HOUSE FOR BREAKING PURPOSES.

Month.	Total. receipts.	Seconds and checks, good eggs.		Bad eggs.	
	Dozen.	*Dozen.*	*Per cent.*	*Dozen.*	*Per cent.*
July	27,024½	25,230	93.4	1,794½	6.6
August	27,948¼	24,953¾	89.3	2,994½	10.6
Total	54,972$\frac{7}{12}$	50,183¾	91.3	4,788⅝	8.7

In order to give farmers, hucksters, grocers, etc., an inducement to improve the quality of the eggs they sell, and in order to put the buying of eggs on the same basis as the buying of other commodities, all the cooperating houses after June 1 purchased all of their eggs on a quality basis.

Instructions in the cooperating houses were to the effect that only eggs with whole yolks, excluding "blood rings" and those having blood clots or mold, should be graded by the candle as fit for food purposes. In the spring, but more especially later in the season, it was observed that the grading of eggs by the candle as ordinarily practiced was far from accurate. Bad eggs were passed as good eggs, and vice versa. The correction of these errors to save food eggs and to prevent objectionable eggs going to the breaking room and there contaminating and spoiling good eggs was of sufficient importance to warrant careful consideration by both the industry and the investigators. The detailed results of this investigation will be presented in another publication. The practical application of the findings may be summarized as follows:

The keynote of accurate grading is a knowledge of the quality of eggs and good management. First, there must be a foreman in each candling room who is not only an expert candler but also a good executive. Second, each case or pail of eggs should be tagged with the number of the individual candler that he may have a sense of responsibility and that the accuracy of his candling may be determined. Third, the candlers should be instructed to place all eggs difficult to grade with the rejects or in a container by themselves in order to reduce the number of bad eggs going to the breaking room. Fourth, the foreman of the breaking room should be on the alert to detect bad eggs which are present in breaking stock due to errors in candling and to report the same to the candling room. Fifth, all doubtful eggs should be recandled by an expert to recover those which are good. E and F houses operated their candling room according to this system with excellent results.

GRADING IN THE BREAKING ROOM.

If good organization was important in the candling room, it was even more so in the breaking room; here the product (good eggs being furnished) gained or lost in quality, depending upon the mode of handling. Here, also, the cost of preparation increased or decreased with the efficiency of the working force. First in importance was the foreman, for upon him should rest the responsibility of the work of the breaking force and the condition of the ultimate product. He should be able to command the respect of his subordinates, be conversant with the fundamental principles of bacterial cleanliness, and be familiar with the different types of eggs occurring in breaking stock.

Owing to the decided changes made in equipment and methods, the routine work in the breaking room in 1912 was quite different from that of 1911. The duties of the foreman the second season included the enforcement of the following: Clean manipulation of the egg during breaking, the proper method of grading, the changing of apparatus and the cleaning of hands after breaking a bad egg, the correct speed for breaking, the thorough washing and sterilization of utensils, and the maintenance of discipline in the breaking force.

Since the presence of one infected egg would contribute myriads of bacteria to the liquid product, the study of the grading of eggs out of the shell became a very important part of the work. As has been stated, the candling of eggs is a very efficient means of eliminating bad eggs from breaking stock, but it is by no means accurate. It is also generally understood by those familiar with eggs before the candle and out of the shell that there are some types of objectionable eggs, such as musty or sour eggs, which can only be detected when broken. The laboratory findings on composite samples of eggs graded to definite types and broken under clean commercial conditions showed, as given in Bulletin 51 of the U. S. Department of Agriculture, the following facts:

The majority of the samples of white rots, eggs with yolk lightly adherent to the shell, and all of the samples of sour eggs, black rots, eggs with green albumens, eggs with yolk heavily adherent to the shell, and all other eggs with bad odors, were infested with bacteria. *B. coli* were present in most of these eggs and constituted the predominating organism in sour eggs.

The eggs with yolk lightly adherent to the shell were slightly lower in quality than the regular breaking stock eggs, whereas the sour eggs, white rots, eggs with green whites, and eggs with yolk heavily adherent to the shell showed considerably more deterioration. Eggs with bloody whites, or eggs with blood rings, should not be used. The cause of the musty egg, the odor of which increases on heating, thereby creating disaster in the bakery, has not been determined.

The candler aimed to eliminate all of these types of egg from breaking stock except sour and musty eggs and eggs with green whites. As a matter of fact, blood

rings, white rots, and eggs with yolk lightly stuck to shell were frequently miscandled. Cracked eggs with moldy shells were not always detected by the candlers.

This condition of affairs made it necessary that the breakers be able to recognize all kinds of bad eggs, for upon them rested the final responsibility of eliminating bad eggs from the finished product. It was, therefore, incumbent upon the foreman to select well-qualified girls. If a breaker, for instance, did not have a delicate sense of smell she would not be able to detect incipient forms of musty eggs, sour eggs, etc.; or, if she were not quick of perception, she would not recognize eggs with light green whites, etc. The importance of accurate grading is emphasized by the fact that one musty egg would spoil over 30 pounds of liquid egg, worth at least $5. If, on the other hand, she threw away eggs fit for food purposes, she incurred a financial loss to the company.

The preservation of strict order among the breakers was a matter of importance. If a girl, for instance, gossiped with her neighbor, she not only broke fewer eggs but her grading suffered. If she chewed gum she blunted her sense of smell. In order to encourage good steady work and at the same time give the girls a rest from the continuous breaking of eggs, which involves constant attention and the repeated use of the same muscles, they were given, in addition to the noon hour, a recess of about 15 minutes in the middle of each half day. They were allowed to go out of the room, move about, and to converse freely. Such relaxation enabled the girls to do more and better work.

SPEED OF BREAKING.

After the routine of 1912 had become well established observations were made of the time required to take the necessary steps to break and grade an egg and also of the average number of eggs broken per minute, and during longer intervals of time. The results may be summarized as follows:

The speed of breaking depends upon the breaker, the quality of the eggs, and the character and arrangement of the equipment. The split-second timer showed that the successive motions made by the best breakers were as rythmic as those of a machine. The number of eggs broken per minute averaged from 12 to 16, or from 12 to 16 cases of 30 dozen eggs each per working-day of 10 hours. These figures refer to the breaking of eggs without separating into white and yolk. The breakers at E house were the swiftest, those of F house slightly slower, and those at D house the slowest.

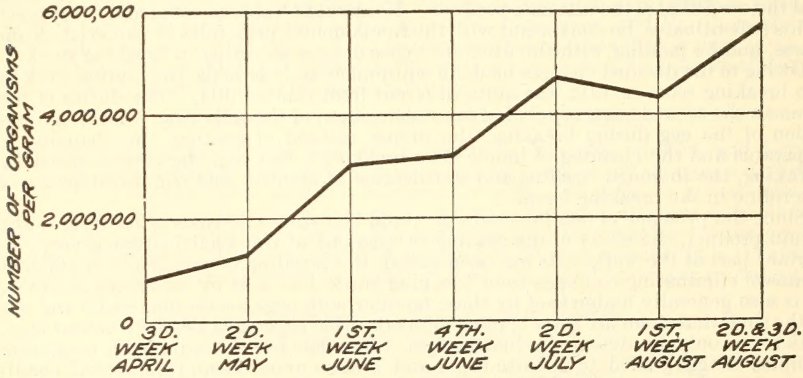

FIG. 1.—Diagram showing the seasonal variation in the bacterial content of the commercial product of E house in 1912.

In E house the pails of eggs, the breaking outfit, the chute for the shells, and the container for the liquid product were so arranged that the motions required to break an egg were minimized and were all in one direction. In F house half of the force worked left-handedly because the egg supply was contained in egg cases. The case would be right-handed for one girl and left-handed for the girl working opposite. It took longer to remove eggs from cases, particularly if they were in fillers, than it did from pails. In D house the breakers dropped the shells into a container on the floor at the side instead of into a hopper directly in front. The former was slower. These small differences mean but a few tenths of a second for each egg broken, but aggregate minutes and hours when the whole working-day is taken into consideration. Other factors being eliminated, it was found that a girl working from left to right could break over 40 dozen more eggs per day than if she worked in the opposite direction.

It was also observed that the arm could empty cups more quickly than the nose could notify the brain of the odor of the contents. For example, a breaker may be surprised to find that she has put a "light must" or a "beginning sour" into the container for good eggs before her mind has apprised her of the character of the egg. For this reason a limit should be set to the number of eggs broken in a given time. Though the girls were not paid according to the quantity of work accomplished, there was an inherent tendency for some to break very rapidly. The supervisor should make it as much of a point to slacken the pace of these workers as to hurry those who are slow. With the present equipment and methods a girl should not break more than 16 eggs per minute, and if the breaking stock contains many bad eggs the limit should be reduced to 12.

SEASONAL VARIATION IN QUALITY OF PRODUCT.

The practical man is familiar with the seasonal variation in the quality of the egg supply. His knowledge is more often confined to the differences in the condition of the eggs in the shell than to that of the frozen and dried products. Since the latter, in the houses under observation, were prepared from eggs which were graded by the senses as fit for food purposes, this is to be expected since small differences in quality can only be detected by careful laboratory procedures.

In order to determine what part weather conditions played in the ultimate product, samples were taken systematically in two houses during the season of 1912.

TABLE 2.—*Seasonal variation in bacterial content of commercial samples of mixed egg. (D house, 1912.)*

Period of sampling.	Number of samples.	Average number of bacteria per gram.	Ammoniacal nitrogen (Folin method).		Average atmospheric temperature prevailing 15 days before sampling.	Rainfall during the 15 days previous to sampling.
			Wet basis.	Dry basis.		
			Per cent.	*Per cent.*	°*F.*	*Inches.*
May 27 to 29	4	640,000			79	0.05
June 1 to 15	11	660,000	0.0018	0.0061	83	.42
June 17 to 27	4	570,000	.0020	.0067	74	2.78
July 1 to 12	5	650,000	.0022	.0072	83	.12
July 16 to 31	10	1,400,000	.0022	.0070	93	.80
Aug. 10 to 13	3	1,500,000	.0020	.0065	87	2.88
Aug. 19 to 23	7	1,700,000	.0021	.0068	87	3.97

These studies show that there is a tendency for the bacterial count and the amount of ammoniacal nitrogen to increase as the egg-breaking season progresses (see Tables 2 and E–IV, appendix, and figure 1).

CLASSES OF EGGS PRESENTING SPECIAL PROBLEMS.

LEAKING EGGS.

Eggs with shell and inner membranes broken are termed "leakers" by the trade. There are all gradations, from the egg which has lost very little of its contents to the egg which has practically nothing left in its shell but the yolk.

During periods of the year when receipts are low and the number of leakers consequently few, they are commonly sold in the shell to near-by consumers and employees of the packing house. In the season of heavy receipts, when there are more leakers than can be used locally, they are either thrown out with the rots or broken out and frozen. The second method of disposal is the one concerned in this investigation.

Formerly if the leakers were to be conserved for food purposes, the candlers sorted these eggs from receipts as they worked and either broke them immediately into a container near by or placed them in pans or pails to be opened in another room. Neither method was satisfactory. If the eggs were opened in a dark candling room they could only be graded in the shell, which was insufficient. Then, too, it was impossible to break eggs under sanitary conditions in a candling room. On the other hand, if the leakers were placed in pails, the damage to the shell was increased, and

a large part of the contents ran over the shells and collected around the eggs in the bottom of the pail, thereby making it impossible to prepare a clean product from leakers handled in this manner.

TRAY METHOD OF HANDLING LEAKERS.

To avoid these difficulties a tray method of handling leakers was devised. The tray was made of galvanized iron and consisted of a drip pan upon which was placed a plate with perforations for holding the leaking eggs. (Pl. XIII, fig. 2.) The openings were round and about $1\frac{3}{8}$ inches in diameter, or hexagonal with sides about six-tenths of an inch in length. The plate was kept in position by means of solder in the corners of the drip pan, or by projections soldered on the sides about 1 inch from the bottom. The trays were 1 to 2 inches high, with perpendicular or beveled sides, and 1 foot square or 1 foot wide by 2 feet long, the former having a capacity of 3 dozen eggs, the latter 6 dozen. The smaller size was much more convenient because it took up less space in the candling room.

After a leaking egg was candled it was placed, damaged end up, in one of the holes of the tray. When filled the tray was carried to the breaking room, where the eggs were broken and graded. The breaking and grading of these eggs was delegated to a few expert girls, because it was impossible to grade leakers as closely by the candle or to break them in as cleanly a manner as cracked or sound eggs. The leaking eggs were opened with the thumb and the two first fingers of each hand, and in many instances without using a breaking knife. Precaution was taken to keep the leaking end of the egg down while the egg was being opened so that the contents would drop into the cup instead of running over the shell and wetting the fingers of the breaker. The same principles used in the grading of the regular breaking stock were used for leakers, except that the grading of soft eggs was done much more closely.

During the first part of the season bacteriological and chemical tests were made of six small samples of leaking eggs collected in the candling room and opened and graded carefully in the breaking room. The results are given in Table 3. These results compared favorably with those obtained from contemporaneous samples of eggs broken from cracked and whole eggs, and warranted further investigation of leaking eggs to determine whether they could safely be conserved for food purposes.

TABLE 3.—*Experimental samples of leaking eggs, opened in the breaking room (D house, 1912).*

Sample No.	Source.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Ammoniacal nitrogen (Folin method).		Moisture.	Number of eggs in sample.
			20° C.	37° C.		Wet basis.	Dry basis.		
						Per cent.	*Per cent.*	*Per cent.*	
4273	D-1	May 8	2,100	1,300	10,000	0.0015	0.0053	71.91	13
4274	D-1	do	16,500	4,200	0	.0013	.0045	70.83	13
4275	D-1	do	45,000	34,500	10,000	.....	.....	.....	6
4284	D-1	do	37,000	5,000	100	.0019	.0067	71.53	12
4286	D-1	do	100,000	62,000	10	.0013	.0046	71.85	12

Laboratory tests of three samples of leaking eggs broken in the candling room at F house during May showed a variation of from 1,600,000 to 25,000,000 per gram in the bacterial count, and of 10,000 to 100,000 per gram in the number of presumptive *B. coli*. (Table 4.) Sample No. 4370, representing 150 pounds of leakers, broken in the candling room of F house during the latter part of May, showed the high count of 25,000,000 organisms per gram, but a low amount of ammoniacal nitrogen, namely, 0.0020 per cent on the fresh basis and of 0.0067 per cent on the dry basis. These results indicate that most of the eggs in the product were sound, but that there were some highly contaminated eggs in the mass. Their presence was probably due to the impossibility of eliminating infected eggs when opening leakers in a candling room. Results of samples taken about a month later, but handled by the tray method, gave as shown in Table F–X (appendix) bacterial counts varying from 23,500 to 1,700,000 per gram and the number of presumptive *B. coli* between 10 and 10,000 per gram. These results indicated, therefore, that the minimum count of the samples of leaking eggs opened in the candling room was, approximately, the same as the maximum count of those opened in the breaking room; and that the presumptive number of *B. coli* was also, in most cases, higher in eggs handled by the old method.

TABLE 4.—*Commercial samples of leaking eggs broken in the candling room (F house, 1912).*

Sample No.	Source.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.	Ammoniacal nitrogen (Folin method).		Moisture.	Weight of sample.
			20° C.	37° C.			Wet basis.	Dry basis.		
							Per ct.	*Per ct.*	*Per ct.*	*Lbs.*
4214	F-1	May 1	4,300,000	2,100,000	10,000	1,400,000	0.0017	0.0054	69.74	420
4224	F-1	May 2	3,800,000	1,800,000	100,000	430,000	.0016	.0054	70.35	.....
4243	F-1	May 3	1,600,000	950,000	10,000	650,000	.0017	.0062	72.55	.....
4370	F-2	May 23	25,000,000	6,300,000	100,000	12,000,000	.0020	.0067	70.09	150

GRADING LEAKING EGGS.

An analysis of the kind and number of rejects found on breaking 350 dozen candled leakers handled by the tray method, showed that 5.2 per cent consisted of deteriorated eggs, which could have been detected by careful candling had the eggs been whole or merely cracked, and 4.4 per cent of infected eggs which could have been eliminated out of the shell. The percentage and kinds of eggs making up the 5.2 per cent of deteriorated eggs ordinarily detected in candling were as follows:

	Per cent.		Per cent.
White rots	57.8	Eggs with blood rings	6.9
Eggs with moldy shells	17.8	Eggs with yolk nearly mixed with white	5.9
Eggs with adherent yolk	7.8	Rotten eggs	3.6

Following are the percentage and kinds of eggs making up the 4.4 per cent of infected eggs which could only be detected out of the shell:

	Per cent.		Per cent.
Sour eggs	40.1	Eggs with a moldy odor	3.7
Soft eggs	30.4	Eggs with an abnormal odor (not bad)	2.1
Eggs with a green white	20.8	Eggs with a bad odor	2.6

From these results it is seen that of the badly deteriorated eggs occurring among leakers, white and sour rots, eggs with moldy shells and soft eggs were the most frequent.

Since a portion of the contents of leaking eggs has been lost, it would be expected that a smaller amount of liquid egg would be obtained from these eggs as compared with that from cracked or whole eggs. That this is the case is shown by the fact that an average of 27.7 pounds of liquid egg were obtained from eight different lots of 30 dozen leaking eggs, as compared with an average of 34 pounds from a large number of cases of cracked and whole eggs.

LABORATORY RESULTS ON LEAKERS HANDLED COMMERCIALLY BY THE TRAY METHOD.

Fifty-three samples were taken of leaking eggs handled on trays and opened in the breaking room; 17 were obtained at D house, 16 at E house, and 20 at F house. The laboratory findings are given in detail in Tables D–IV, E–VII, and F–X, respectively (appendix, pp. 99, 77, and 89), and are summarized in Table 5.

TABLE 5.—*Summary of laboratory results on leaking eggs, tray method of handling, 1912.*

I. BACTERIOLOGICAL DATA.

House.	Number of samples.	Number of organisms per gram.			Gas-producing bacteria per gram in lactose bile.	
		Minimum.	Maximum.	Average.	Minimum.	Maximum.
D	17	500	3,700,000	470,000	0	100,000
E	16	200,000	6,000,000	2,800,000	0	100,000
F	20	23,500	4,500,000	910,000	0	1,000,000

TABLE 5.—*Summary of laboratory results on leaking eggs, tray method of handling, 1912*—Continued.

II. CHEMICAL DATA.

House.	Number of samples.	Percentage of ammoniacal nitrogen.						Percentage of moisture.		
		Wet basis.			Dry basis.			Minimum.	Maximum.	Average.
		Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.			
D	13	0.0013	0.0022	0.0017	0.0047	0.0076	0.0058	69.07	72.83	71.18
E	11	.0020	.0028	.0023	.0066	.0079	.0074	64.12	70.60	68.16
F	13	.0015	.0028	.0020	.0049	.0080	.0065	65.59	71.42	69.33

The bacterial counts and the percentages of ammoniacal nitrogen of samples of good quality leaking eggs handled by the tray method, broken in a cleanly manner and graded carefully, were no greater than those found in synchronous samples of seconds, dirty, or cracked eggs.

Samples with high bacterial counts and, in some cases, with high percentages of ammoniacal nitrogen are grouped in Table 6. In most instances these results could be traced to poor grading during breaking or to low-grade receipts from which the leaking eggs were sorted.

TABLE 6.—*Commercial samples of low quality, leaking eggs, tray method, 1912.*

Sample No.	Source.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.	Ammoniacal nitrogen (Folin method).		Moisture.	Size of sample.	Number of discards.
			20° C.	37° C.			Wet basis.	Dry basis.			
							Per ct.	*Per ct.*	*Per ct.*	*Doz.*	
4503	F-3	June 11	4,900,000	3,300,000	10,000	1,800,000	0.0022	0.0074	70.13	6	4
4526	F-3	June 12	19,000,000	15,000,000	100,000	800,000	.0021	.0068	69.18	6	.....
4737	E-5	July 13	36,000,000	3,000,000	10,000	.....	.0029	.0105	72.43	24	53
4858	D-5	July 29	14,000,000	19,000,000	10,000	.....	.0019	.0064	70.43	6	16
4859	D-5	do	20,000,000	67,000,000	100,000	.....	.0019	.0065	70.58	6	9

The amount of moisture averaged 71.18 per cent in the 13 samples of leaking eggs taken at D house, 68.16 per cent in the 11 samples taken at E house, and 69.33 per cent in the 15 taken at F house. These figures were lower than those found when cracked or whole eggs were examined, due to the fact that some of the white, which contains considerably more water than the yolk, had been lost.

SOFT EGGS.

Eggs which are not separable into white and yolk are termed soft eggs in this report. This egg is illustrated in Plate XIV. It may have a whole yolk before the candle, but may be ruptured during the process of breaking.

Thirteen samples of soft eggs were taken, in which there was observed a considerable variation in both the bacterial content and the amount of ammoniacal nitrogen. For example, 53.8 per cent of the samples contained less than 5,000,000 bacteria per gram, and 46.2 per cent, between 6,100,000 and 80,000,000 per gram. (See Table F–VIII, Appendix.)

The samples with counts under 5,000,000 contained an average of 0.0021 per cent of ammoniacal nitrogen on the wet basis and 0.0074 per cent on the water-free basis; those with counts over 5,000,000 showed an average of 0.0026 per cent on the wet basis and of 0.0086 per cent on the water-free basis. The average amount of loosely-bound nitrogen in the samples of soft egg, with counts under 5,000,000 per gram, is practically the same as that found in samples of whole egg which could be separated into white and yolk.

It is evident from these results that a large percentage of soft eggs contain comparatively few organisms and a comparatively small amount of loosely bound nitrogen, and also that others are markedly infected and deteriorated. It is quite probable that infected soft eggs are incipient forms of sour eggs, white rots, etc., which have not yet acquired their identifying characteristics.

SECOND-GRADE FROZEN EGGS.

The second-grade product was prepared from eggs showing incipient deterioration by the senses and from drippings from the breaking knife. By far the greatest number of the samples of these eggs showed, as given in Table F–V (Appendix, p. 84), decided infection and marked deterioration. The average bacterial count was 35,000,000 per gram; and the average amount of ammoniacal nitrogen, 0.108 per cent on the dry basis. These results are considerably higher than those found in any of the first-grade products (see Tables 11 and 12).

Samples were taken of some of the component eggs of the second-grade product. The results are correlated in Table F–XII (Appendix, p. 92). Both the incipient sour eggs and the eggs with white beginning to turn green contained millions of bacteria and a comparatively large amount of ammoniacal nitrogen. These data show very plainly that it is impossible to detect by the senses sour eggs or eggs with green whites until the bacteria have developed in sufficient numbers to cause a partial decomposition of the egg material. Cracked eggs with moldy shells, even though the appearance and odor of their contents were normal, frequently contained many organisms. The amount of ammoniacal nitrogen was, however, not excessive.

The bacterial count of nine samples of drippings from breaking knives and trays varied from 10,000 to 13,000,000. There were between 100 and 100,000 *B. coli* per gram in the different samples. This drip contributed fewer organisms to the second-grade product than did the eggs showing incipient deterioration by the senses.

The wide variation of 71.79 to 84.60 per cent of moisture was due to the difference in the amount of drippings or white present.

These results show very conclusively that incipient forms of sour eggs, eggs with green whites, etc., are not only heavily infected but are distinctly decomposed. The laboratory studies of the second-grade product coincide with the decision of the senses as applied to the eggs constituting it, namely, that it is unfit for food purposes.

TANNERS' EGGS.

Tanners' eggs are prepared from the discards from the candling and breaking room minus the eggs with a bad odor, or, in other words, all eggs admittedly unfit for food except those with a repugnant odor. The latter are not included because they would be disagreeable for the tanners to handle. The eggs regularly graded for tanners' purposes are as follows:

Candling-room discards.—White rots, eggs with moldy shells, eggs with adherent yolks, eggs with blood rings, and eggs with yolk nearly mixed with white, etc.

Breaking-room discards.—Sour eggs, eggs with green whites, eggs with a moldy odor, other eggs with abnormal odors, and good eggs, when bad eggs are broken in a cup with them, etc.

Many of these eggs are illustrated in Bulletin 51 of the U. S. Department of Agriculture; others are shown in this report in Plates XV and XVI.

In Table 7 are given the laboratory findings in samples of tanners' eggs, four of which were prepared from eggs discarded in the candling room and six from eggs rejected in the breaking room. It will be noted that every sample is heavily infected with organisms and that with few exceptions those prepared in the breaking room were about twice as heavily infected as those made from eggs discarded during candling. This difference would have been still greater had no good eggs been present in the former.

The number of bacteria in tanners' eggs varied from 31,000,000 to 150,000,000, being markedly greater than the average count found in the samples of first-grade eggs. The minimum figure, however, is not far from the average bacterial content of the second-grade product, i. e., 35,000,000.

The amount of chemical decomposition was also greater in the tanners' grade prepared from eggs rejected in the breaking room than in that made from the bad eggs found on candling. The average amount of ammoniacal nitrogen found in the former was 0.0099 per cent on the dry basis and in the latter 0.0160 per cent.

TABLE 7.—*Commercial samples of tanners' egg.*

Sample No.	Source.	Size and description of sample.	Date of collection 1912.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.	Ammoniacal nitrogen (Folin method).		Moisture.
				20° C.	37° C.			Wet basis.	Dry basis.	
		I.								
		Commercial discards, minus rots with bad odor, from candling room:						*Per cent.*	*Per cent.*	*Per cent.*
4528	F-3	Churn	June 12	45,000,000	33,000,000	1,000,000	2,300,000	0.0025	0.0087	71.34
41014	D-6	15 dozen; mostly large old blood rings and eggs with broken-down yolks previously adherent to shell	Aug. 19	46,000,000	33,000,000	1,000,000	.....	.0034	.0119	71.38
41035	D-6	7 pounds; mostly large broken-down blood rings	Aug. 21	31,000,000	11,000,000	100,000	.....	.0021	.0074	71.64
41068	E-7	15 dozen	Aug. 27	65,000,000	73,000,000	1,000,000	.....	.0033	.0115	71.40
		II.								
		Commercial discards from breaking-room:								
4195	E-1	15 pounds	Apr. 26	100,000,000	17,000,000	1,000,000	.....	.0069	.0219	68.53
4220	F-1	30 pounds	May 2	46,000,000	12,000,000	1,000,000	11,000,000	.....	.....	.....
4348	E-2	12 pounds	May 17	130,000,000	24,000,000	1,000,000	.....	.0041	.0146	71.89
4555	D-3	30 pounds	June 17	110,000,000	56,000,000	1,000,000	20,000,000	.0047	.0156	69.82
4561	D-3	35 pounds	do	150,000,000	68,000,000	10,000,000	60,000,000	.0055	.0157	65.06
4569	D-3	70 pounds	June 18	39,000,000	20,000,000	1,000,000	6,000,000	.0039	.0124	68.73

COMPARATIVE STUDY IN TWO HOUSES ON EGGS BEFORE AND AFTER DESICCATION.

The belt system used in E and F houses differed in some respects. In E house the hot air entered the ducts in which the belts circulated through several flues and was expelled through two others. In F house there was one inlet and one outlet for the hot air. By the arrangement of the air ducts in E house the supply of air coming in contact with the drying egg was replenished before it had become saturated with moisture. The temperature of the intake air in E house varied from 135° F. to 160° F. for whole egg, and in F house it was 160° F. for yolk and 140° F. for mixed egg. The temperature of the outgoing air was about 10° lower in E house and about 30° lower in F house than the incoming air. E house desiccated about 150 pounds of whole egg in one hour and F house about 80 pounds.

The belts of E house were considerably longer than those of F house; consequently they were supported on the lower side by rollers. The portion of the egg on the belt coming in contact with these rollers did not dry as quickly as the films of eggs on the exposed sections of the belt. As a result, sticky masses, commercially termed "wet lumps," were mixed with the flaky egg scraped from the belts. The imperfectly dried portions, however, represented but a small amount of the final product. They were screened and subjected to further drying. The average moisture content of the dried product immediately after being removed from the belts was at E house 8.82 for the whole egg. E house did not subject the dried egg to secondary drying. F house, however, exposed the product to a temperature of 100° F. for about five hours. The percentage of moisture then averaged 6.13 for the mixed egg and 5.04 for the yolks, as against 11.24 per cent for mixed egg and 11.21 per cent for yolk when the dried egg was removed from the belts.

BACTERIAL CONTENT.

Eighteen comparative examinations were made of the product in E house before and after desiccation. The results given in Table E–V (Appendix, p. 74) show in practically every case (if the count of the dried product be divided by 3 to make it comparable with the liquid egg) that there is a reduction in the number of bacteria during the process of desiccation.

The lowest count found in samples of the flaky dried egg, as shown in Table E–III (Appendix, p. 70), was 65,000 per gram and the highest 20,000,000. The average count for the 48 samples was 3,600,000. The number of *B. coli* varied from 0 to 1,000,000 per gram. Only 6, or 12.5 per cent, contained 1,000,000. (Table E–VIII, Appendix, p. 78.)

The bacterial content of the samples of "wet lumps" averaged 6,900,000 and varied from 1,100,000 to 18,000,000 per gram. Corresponding samples of flaky egg contained between 430,000 and 12,000,000 organisms per gram (Table E–II). Comparative results, given in Table E–II (Appendix, p. 68), indicate that in some instances there is a multiplication of organisms in wet lumps during the process of desiccation. There was practically no difference in the bacterial content of wet lumps before and after secondary drying.

In the spring of the year there was practically no increase in the number of bacteria during drying. In the summer, however, there was appreciable multiplication during desiccation (see Table F–I, Appendix, p. 80). This is undoubtedly due to the warmer weather and the greater amount of water in the air during the summer.

It is probable that an increase in the air supply to the belts and an increase and rearrangement of the inlet and outlet ducts would facilitate desiccation and prevent multiplication of bacteria without diminishing the solubility of the dried product.

AMMONIACAL NITROGEN.

The amount of ammoniacal nitrogen found in the desiccated products of E and F houses is not comparable with the amount present in liquid egg before drying. For example, the parallel tests given in Table E–V (Appendix, p. 74) showed that the percentage of ammoniacal nitrogen calculated on the dry basis varied from 0.0073 to 0.0093 in the liquid egg and from 0.0009 to 0.0016 in the corresponding product after desiccation. Similar variations can be seen in Table F–VI (Appendix, p. 76). These results indicate that a portion of the ammoniacal nitrogen was volatilized during desiccation.

The amount of ammoniacal nitrogen volatilized from the product during desiccation is not constant, according to the above tables. For instance, samples 41079 and 41085 listed in Table E–V contained 0.0093 per cent of loosely bound nitrogen in the liquid form, but after desiccation one contained 0.0009 per cent and the other 0.0015 per cent. Since, therefore, the amount of loosely bound nitrogen lost from eggs during drying is

variable, it is not possible to judge the quality of the liquid egg from the quantity found in dried egg, or vice versa.

A comparison of the amount of ammoniacal nitrogen and the bacterial content of dried whole egg, dried mixed egg, and dried yolks shows, as can be observed in Tables E–V, F–II, and F–IV, a tendency to greater quantities of ammoniacal nitrogen when the product is heavily infected with bacteria, but the relation between the two is far from being as definite or as conclusive as when the tests are applied to liquid egg.

COMPARISON OF THE LIQUID PRODUCT FROM THREE HOUSES IN 1912.

There was but slight variation found in the amount of ammoniacal nitrogen in the commercial liquid products prepared by the cooperating houses in which the mode of preparation was the same. The average bacterial contents of the liquid products of D and F houses, which derived their breaking stock mostly from their current receipts, were nearly the same. The number of bacteria in the liquid egg of E house was greater than for the other two houses. The latter purchased its breaking stock from other houses; consequently it was somewhat older at the time of breaking than that of the other two houses. The data summarizing the findings for the three houses are given in Tables 8, 9, 10, E–VIII (Appendix), and F–XI (Appendix).

TABLE 8.—*Summary of laboratory results on commercial samples taken in D house during 1912.*

I. CHEMICAL RESULTS.

Description of sample.	Number.	Percentage of ammoniacal nitrogen.						Percentage of moisture.		
		Wet basis.			Dry basis.					
		Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.
Whites	7	0.0004	0.0002	0.0006	0.0028	0.0016	0.0046	87.27	86.96	87.90
Yolks	13	.0029	.0024	.0037	.0070	.0054	.0083	57.79	53.64	64.06
Mixed egg	34	.0020	.0014	.0025	.0067	.0046	.0082	69.46	68.33	71.43

II. BACTERIOLOGICAL RESULTS.

Organisms per gram.	Whites.		Yolks.		Mixed egg.	
	Number of samples.	Per cent.	Number of samples.	Per cent.	Number of samples.	Per cent.
0 to 10,000 inclusive	3	13.6	3	15.0	1	2.2
10,001 to 50,000 inclusive	4	18.2	3	15.0	.....	.....
50,001 to 100,000 inclusive	3	13.6	3	15.0	.....	.....
100,001 to 500,000 inclusive	8	36.3	3	15.0	14	30.4
500,001 to 1,000,000 inclusive	3	13.6	5	25.0	15	32.6
1,000,001 to 5,000,000 inclusive	1	4.5	3	15.0	16	34.8
Total	22	.....	20	.....	46	.....
Average	280,000		480,000		1,000,000	
Minimum	100		200		5,100	
Maximum	1,500,000		2,100,000		3,300,000	

Number of organisms per gram producing gas in lactose bile.	Whites.		Yolks.		Mixed egg.	
	Number of samples.	Per cent.	Number of samples.	Per cent.	Number of samples.	Per cent.
Less than 10	4	19.0	2	11.1	.....	.....
10	2	9.5	1	5.6	.....	.....
100	3	14.3	4	22.2	3	6.5
1,000	6	28.6	5	27.7	11	23.9
10,000	4	19.0	2	11.1	15	32.6
100,000	2	9.5	2	11.1	15	32.6
1,000,000	.....	.....	2	11.1	2	4.3
Total	21	.....	18	.....	46	.....

TABLE 9.—*Summary of laboratory results on commercial samples taken in E house during 1912.*

I. CHEMICAL RESULTS.

Description of sample.	Table No.	Number of samples.	Percentage of ammoniacal nitrogen.						Percentage of moisture.		
			Wet basis.			Dry basis.					
			Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.
Whites	E-VI	3	0.0005	0.0005	0.0006	0.0044	0.0040	0.0049	87.84	87.55	88.31
Yolks	E-VI	4	.0035	.0029	.0039	.0083	.0072	.0092	58.37	57.72	59.56
Whole eggs	E-IV	32	.0021	.0016	.0024	.0075	.0054	.0087	72.33	70.23	74.17

II. BACTERIOLOGICAL RESULTS.

Description of sample.	Table No.	Number of samples.	Per cent of samples with counts over 5,000,000 per gram.	Number of organisms per gram.		
				Average.	Minimum.	Maximum.
Liquid eggs:						
Whites	E-VI	7	0	730,000	1,000	1,800,000
Yolks	E-VI	6	0	630,000	5,500	1,300,000
Whole eggs	E-IV	38	26.3	3,100,000	700,000	11,000,000
Desiccated whole eggs:						
Flaky eggs	E-III	48	20.8	3,600,000	65,000	20,000,000
Wet lumps	E-II	26	50.0	6,900,000	1,100,000	18,000,000

TABLE 10.—*Summary of laboratory results on commercial samples taken in F house during 1912.*

I. CHEMICAL RESULTS.

Description of sample.	Table No.	Number of samples.	Percentage of ammoniacal nitrogen.						Percentage of moisture.		
			Wet basis.			Dry basis.					
			Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.
Whites	21	3	0.0004	0.0002	0.0006	0.0031	0.0016	0.0046	87.13	87.01	87.36
Yolks	21, F-VII	6	.0038	.0034	.0045	.0086	.0075	.0103	55.87	53.74	57.25
Whole eggs	F-IX	5	.0020	.0019	.0021	.0070	.0067	.0071	72.34	71.62	73.29
Sugared yolks	F-VII	7	.0030	.0028	.0033	.0062	.0058	.0067	51.12	49.89	53.07
Mixed eggs	F-III	10	.0023	.0017	.0027	.0071	.0053	.0082	68.06	67.00	70.81
Soft eggs	F-VIII	11	.0023	.0018	.0031	.0080	.0066	.0098	71.24	67.04	72.99
Second-grade eggs	F-V	14	.0023	.0008	.0040	.0108	.0052	.0182	78.20	71.79	84.60

II. BACTERIOLOGICAL RESULTS.

Description of sample.	Table No.	Number of samples.	Per cent of samples with count over 5,000,000 per gram.	Number of organisms per gram.		
				Average.	Minimum.	Maximum.
Liquid eggs:						
Whites	21	10	10.0	[1] 220,000	1,000	7,500,000
Yolks	21, F-VII	28	10.71	[2] 550,000	6,800	7,500,000
Whole eggs	F-IX	9	0	1,300,000	340,000	3,500,000
Mixed eggs	F-III	12	8.33	1,700,000	470,000	6,800,000
Soft eggs	F-VIII	13	46.1	20,000,000	130,000	80,000,000
Second-grade frozen eggs	F-V	14	92.8	35,000,000	4,200,000	92,000,000
Desiccated eggs:						
Yolks	F-II	15	66.6	41,000,000	71,000	110,000,000
Mixed eggs	F-IV	32	59.4	29,000,000	160,000	200,000,000

[1] Two samples with exceptionally high counts not included in this average.
[2] Three samples with exceptionally high counts not included in this average.

GENERAL SUMMARY OF LABORATORY RESULTS ON COMMERCIAL SAMPLES, 1912.

The bacteriological and chemical findings of the data obtained from commercial samples of liquid egg taken in D, E, and F houses during 1912 are summarized in Tables 11 and 12 and shown graphically in figures 2, 3, and 4.

The average number of bacteria per gram in the whites was 350,000, in the yolks 530,000, and in the whole and mixed eggs 1,800,000. The average amount of ammoniacal nitrogen on the dry basis was 0.0031 per cent in the whites, 0.0076 per cent in the yolks, and 0.0074 per cent in the whole eggs.

A comparison of these results shows that the average count of the whites is about half that of the yolks, and that the latter contained approximately one-third as many bacteria as the whole and mixed eggs. The antiseptic action of the white may explain its lower bacterial content as compared with that of the yolks, whole eggs, and mixed eggs. It may be that the presence of soft eggs in the whole and mixed eggs offers also an explanation of their higher bacterial content.

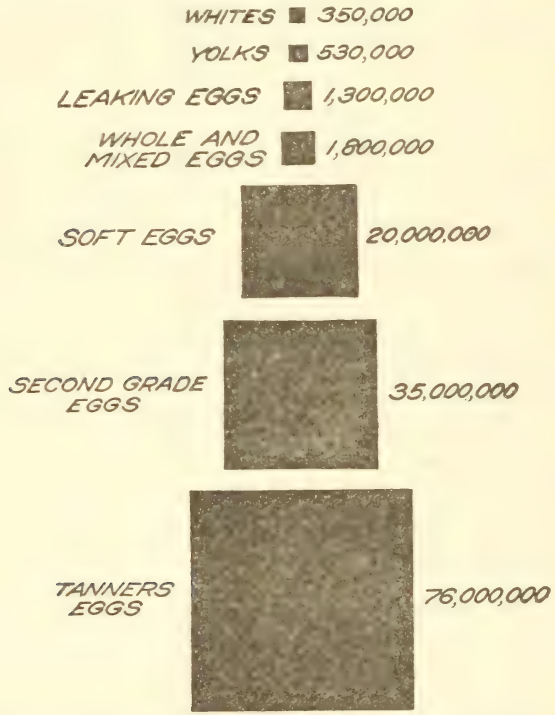

FIG. 2.—Diagram showing average number of organisms per gram in commercial samples taken in D, E, and F houses in 1912.

It is interesting to note that the average count of the product prepared from leaking eggs is not far different from that of the whole and mixed eggs. The average count of the former was 1,300,000 and of the latter 1,800,000.[1] The amount of chemical decomposition was no greater in the leaking eggs than in the whole and mixed egg.

The product prepared from soft eggs graded as fit for food purposes contained decidedly more bacteria than the whole or mixed egg, but the amounts of ammoniacal nitrogen in the two were not so very far apart. The average number of organisms in the soft eggs numbered 20,000,000 per gram, as compared with 1,800,000 in the whole and mixed egg, whereas the percentage of loosely bound nitrogen averaged 0.0080 on the dry basis in the former and 0.0074 in the latter. The bacteria in the soft eggs were not present in sufficient numbers or for a sufficient length of time to effect a decomposition of the egg material.

On the other hand, the second-grade frozen egg prepared from "beginning sours," eggs with light-green whites, etc., and the tanners' egg were not only heavily in-

[1] Weighted average of bacterial content of whole and mixed eggs given in Table 11.

fected but were decomposed. The average number of bacteria in the former was 35,000,000 per gram and in the latter 76,000,000. The amount of ammoniacal nitrogen was 0.0108 per cent on the dry basis in the second-grade egg and 0.0133 in the tanners' egg. These comparative data, together with the practical observations of the eggs used in the former product, show very conclusively that second-grade canned or dried eggs are unfit for food purposes.

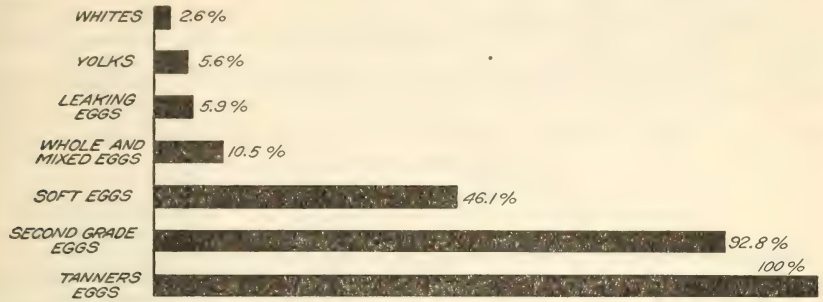

FIG. 3.—Diagram showing percentage of commercial samples with counts over 5,000,000 per gram (samples taken in D, E, and F houses during 1912).

As the houses under observation during 1912 were three of the largest producers of canned and dried eggs in the United States, it is instructive to compare the quality of their output as indicated by its bacterial content with that offered for sale for food during the two years previous to the investigation. Stiles and Bates found in a study of 312 samples of frozen egg collected from different sources during the years of 1909 to 1911, inclusive, that 58.3 per cent contained over 10,000,000 bacteria per gram. Of 216 samples of liquid egg obtained from the cooperating houses during this investigation in 1912, only 1.4 per cent were found to contain over 10,000,000 per gram.[1]

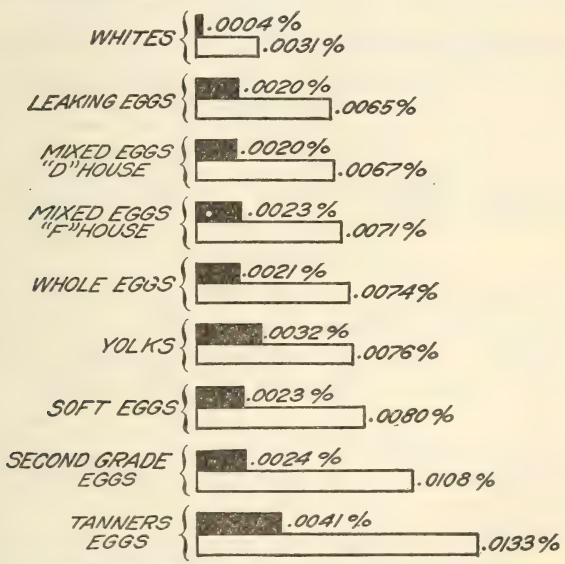

FIG. 4.—Diagram showing average percentage of ammoniacal nitrogen in commercial samples taken in D, E, and F houses during 1912.

The maximum count in the three houses in 1912 was 11,000,000 per gram, while the maximum found by Stiles and Bates was 1,180,000,000.

The difference in the bacterial contents of the samples of dried egg was equally as marked. Stiles and Bates found that 83.3 per cent of the samples purchased on the open market contained over 10,000,000 per gram. Only 6.3 per cent of 48 samples

[1] Stiles and Bates, Bureau of Chemistry, United States Department of Agriculture, Bulletin No. 158, p. 29.

taken in E house contained over this number, while in F house 55.3 per cent of the samples were in excess of 10,000,000.

The maximum number per gram found in the samples of dried eggs taken in 1912 was 20,000,000 for E house and 200,000,000 for F house, and in the samples collected between 1909 and 1911 by Stiles and Bates, 2,100,000,000. It is known in the case of F house that the raw material was of good quality and that the bacteria increased during desiccation.

The samples studied by Stiles and Bates represented not only frozen and dried egg prepared from good eggs by the best methods known at the time, but also products made from unfit raw material.

These comparative data speak well for the quality of the product prepared by the new methods in the three houses under investigation.

TABLE 11.—*General summary of bacterial counts on commercial samples taken in D, E, and F houses during 1912.*

Description of sample.	Table No.	Number of samples.	Per cent of samples with counts over 5,000,000 per gram.	Number of organisms per gram.		
				Average.	Minimum.	Maximum.
Liquid eggs:						
Whites	D-III, 17, E-VI, 21.	39	2.6	[1] 350,000	100	7,500,000
Yolks	D-III, E-VI, 21, F-VII.	54	5.56	[2] 530,000	200	7,500,000
Whole eggs	E-IV, F-IX	47	21.28	2,700,000	340,000	11,000,000
Mixed egg from D house	D-II	46	0	1,000,000	5,100	3,300,000
Mixed egg from F house	F-III	12	8.33	1,700,000	470,000	6,800,000
Leaking eggs	D-IV, E-VII, F-X.	53	5.88	1,300,000	500	6,000,000
Soft eggs	F-VIII	13	46.14	20,000,000	130,000	80,000,000
Second-grade eggs	F-V	14	92.8	35,000,000	4,200,000	92,000,000
Tanners' egg	7	10	100.0	76,000,000	31,000,000	150,000,000

[1] One sample with an exceptionally high count not included in this average.
[2] Three samples with exceptionally high counts not included in this average.

TABLE 12.—*General summary of chemical results on commercial samples taken in D, E, and F houses during 1912.*

Description of sample.	Table No.	Number of samples.	Percentage of ammoniacal nitrogen.						Percentage of moisture.		
			Wet basis.			Dry basis.					
			Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.
Whites	D-III, 17, E-VI, 21.	13	0.0004	0.0002	0.0006	0.0031	0.0016	0.0049	87.37	86.96	88.31
Yolks	D-III, 17, E-VI, 21.	23	.0032	.0024	.0045	.0076	.0054	.0103	57.88	53.64	64.06
Sugared yolks	F-VII	7	.0030	.0028	.0033	.0062	.0058	.0067	51.12	49.89	53.07
Whole eggs	E-IV, F-IX	43	.0021	.0016	.0024	.0074	.0054	.0087	72.33	70.23	74.17
Mixed egg from D house.	D-II	34	.0020	.0014	.0025	.0067	.0046	.0082	68.88	68.33	71.43
Mixed egg from F house.	F-III	10	.0023	.0017	.0027	.0071	.0053	.0082	68.06	67.00	70.81
Leaking eggs	D-IV, E-VII, F-X.	37	.0020	.0013	.0028	.0065	.0047	.0080	69.63	64.12	72.83
Soft eggs	F-VIII	11	.0023	.0018	.0031	.0080	.0066	.0098	71.24	67.04	72.99
Second-grade eggs and drippings.	F-V	14	.0024	.0008	.0040	.0108	.0052	.0182	78.20	71.79	84.60
Tanners' egg	7	9	.0041	.0021	.0069	.0133	.0074	.0219	69.98	65.06	71.89

CONCLUSIONS.

1. Eggs commonly used for breaking stock by reputable firms are small and oversized eggs, dirty and cracked eggs, and shrunken eggs.

2. In order to check deterioration, the eggs should be held in chilled surroundings before and during the process of candling, breaking, and mixing preparatory to freezing or drying.

3. All eggs, even during the spring months, should be candled previous to breaking.

4. In order to insure well-candled eggs going to the breaking room, the system of candling should be such that the work of the individual candlers is checked.

5. In order to prevent waste, the eggs difficult to grade should be set aside by the regular candlers to be recandled by an expert.

6. All eggs used in the preparation of frozen and dried eggs should be graded out of the shell as well as by the candle, because certain heavily infected eggs, such as sour eggs and eggs with green whites, can only be detected when broken.

7. In order to insure a good product, bacterial cleanliness and careful grading must be obtained during the process of preparation.

8. The fingers of the breakers should be kept dry and clean.

9. In order to prevent waste and to insure good grading, not more than three eggs should be broken into a cup before emptying.

10. Good eggs should not be saved when a bad egg has been broken into a cup with them.

11. White and yolk are contaminated less by the mechanical than the shell method of separation. Only clean eggs should be separated by the latter process.

12. The percentage of "rots" rejected on candling and the organisms in the liquid egg saved increases as the season advances.

13. Canned eggs with the majority of samples having counts of less than 5,000,000 bacteria per gram, and with 100,000 *B. coli* or less can be prepared in the producing section from regular breaking stock, provided strict cleanliness and careful grading have been observed. The ammoniacal nitrogen will very seldom be over 0.0024 on the wet basis or 0.0087 on the dry basis.

14. A second-grade frozen product prepared from eggs showing incipient decomposition to the senses, such as "beginning sours" and eggs with green whites, are not only heavily infected but chemically decomposed. These eggs are unfit for food purposes.

15. Only two grades of canned eggs should be prepared when grading eggs out of the shell, namely, food egg and tanners' egg.

16. Leaking eggs handled on special trays between candling and breaking room and graded carefully are as fit for breaking as regular breaking stock.

17. Tanners' egg contains markedly larger numbers of bacteria and larger amounts of ammoniacal nitrogen than does food egg.

18. The control of the supply of air to drying belts to prevent saturation from the liquid egg is an important factor in preventing multiplication of bacteria in the product during the process of desiccation.

19. The amount of ammoniacal nitrogen in desiccated egg is not a reliable index to the quality of the raw material from which it is prepared, because this substance is volatilized unevenly during the process of desiccation.

20. The following eggs should be discarded during grading: Black, white, mixed and sour rots, eggs with green whites, eggs with stuck yolks, musty eggs, moldy eggs, "blood rings," eggs containing diffuse blood, and eggs with abnormal odor.

GLOSSARY.

"Seconds" are small and oversized eggs, dirty eggs, and shrunken eggs.

"Leakers" are eggs with shell and inner membranes broken.

A "blood ring" is a fertile egg in which the embryo has developed sufficiently to show blood.

A soft egg is an egg the yolk of which appears whole before the candle, but breaks when opened.

A "strong-odor" egg is an egg which has an eggy odor.

An "off" egg is an egg which has a slightly abnormal odor.

A "beginning sour" is an egg showing the first signs of the odor characteristic of sour eggs.

"Mixed egg" is a product prepared by adding yolks to whole egg.

"Drip" is the liquid egg, mostly white, which collects in the bottom of the breaking tray while eggs are being broken.

Second-grade egg is a product prepared from "drip" and incipient forms of deteriorated eggs, such as "beginning sours," eggs with light-green whites, etc.

"Tanners' egg" is a product made from the rejects of the candling and breaking rooms, minus eggs with a bad odor. It is used, as the name implies, for tanning leather.

"Flaky egg," as opposed to "wet lumps," is the more thoroughly dried portion of egg coming from the drying belts.

A "churn" is a device for breaking yolks and for mixing yolk and whole egg

APPENDIX.

DETAILS OF EXPERIMENTS IN EACH COOPERATING HOUSE, 1911 AND 1912.

CONDITIONS OBSERVED IN B HOUSE IN 1911.

The Breaking Room.

In B house a small room, about 12 by 12 feet, constructed entirely of concrete, screened, and on the fourth floor of a modern creamery, was set aside for egg breaking. It was not refrigerated. It was clean.

The table used in this house is shown in figure 5. It was covered with zinc, had a shelf at the side to support the egg case, and a hole in the middle of the table through which the shells were thrown into a bucket below. At the back of the table, to the left of the breaker, stood a pail of water. This was used to wash the saucer and the hands of the breaker after a bad egg. The saucer was not dried, consequently it carried water to the shelf on which it rested, keeping the latter continually sloppy, and occasionally drops fell into the containers below. One saucer only was provided, hence it was in constant use. This type of breaking outfit was seen in a number of establishments.

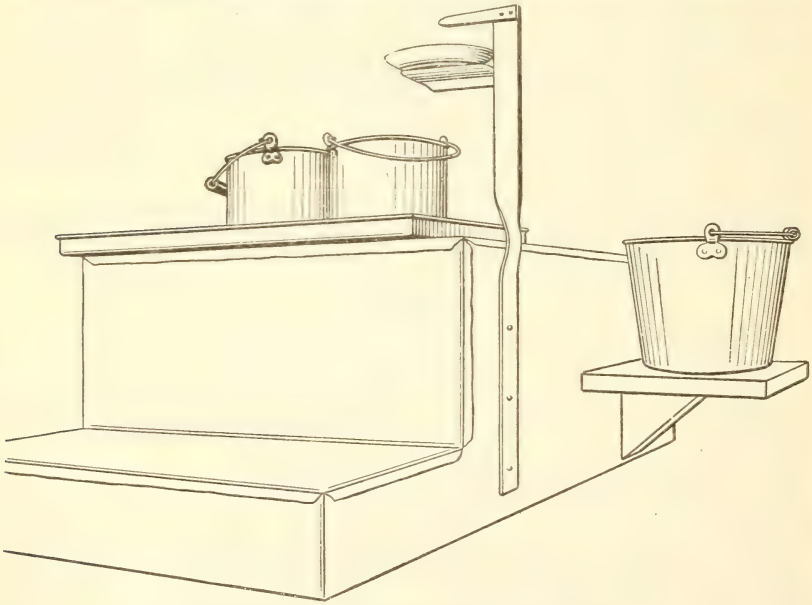

Fig. 5.—Table and breaking outfit (B house, 1911).

The eggs in this house were separated by the shell method when whites and yolks were desired; whole eggs went into the saucer. In the shell-separating method—that is, the usual housewifely fashion of tipping the egg back and forth until the white is drained off—the white ran into a saucer, the yolk was dumped into a small yolk bucket, and the white from the saucer into its bucket. The whites were collected in containers of various sizes, according to the wishes of the trade, and stored at one

side of the room from the beginning of the work in the morning until noontime, when it was removed to the freezer; and again, from the beginning of the afternoon until the close of the day, when a second trip was made to the freezer.

The yolks were put into a 40-quart milk can. This at noontime and again at night was emptied into a large straight-sided can provided with an ordinary creamery faucet. The yolk was poured into this churn through a large mesh wire sieve to remove scraps of eggshell. It was then stirred with a paddle in the churn until the yolks were thoroughly broken and mixed, or the whites and yolks of the whole eggs made into a uniform liquid. The containers were then placed below the faucet of the churn and the egg run into them. The churn was washed at noontime after it was used and again at night.

The eggs were chilled before breaking, but their long wait after removal from the shell in this hot room effectually undid the good which previous chilling does to a perishable product.

Sources of Bacterial Contamination.

In order to determine the bacterial cleanliness of this method and equipment, each obvious factor was tested by laboratory methods for the amount of contamination.

Plate I, figure 1, represents the number of colonies which developed on a 4-inch petri plate from one drop of water taken from the saucer after throwing away a bad egg and washing in running hot water. It is obvious, from the large number of colonies developing, that this method of cleaning the receiver is not sufficient to remove the organisms furnished by the undesirable egg. Plate I, figure 2, shows the number of bacteria in one drop of water which had collected on the shelf holding the wet saucer. Here, again, is a rich source of bacterial contamination of the final product. As one would expect, there are many more organisms in this drop of drip than were obtained from the saucer itself.

The picture of the breaking equipment shows a shallow metal tray that was placed under the egg pails for the sake of cleanliness. This tray gradually collected drippings of water from the saucer and its shelf and of egg which ran down the sides of the pails when their contents were emptied into the milk can; consequently, there were even more organisms in the liquid that accumulated in the tray than there were on either the saucer or the shelf, and when the pails were emptied this liquid sometimes dropped into the final receiver. One drop of it was examined with the result shown in Plate I, figure 3. The organisms as they developed on a 4-inch petri plate were so numerous that it was impossible to distinguish them as individual colonies. Each step of this process added more and more bacteria to the product, though as carried out it was even cleaner than the usual kitchen methods. The breaker had no means of detecting either the source or the amount of the infection that his routine caused.

The bacteria on finger tips wet with egg are shown in Plate I, figure 4. To obtain this preparation, the breaker touched her five wet finger tips against the bottom of a dry, sterile petri plate. Agar was then poured in, shaken to distribute the organisms evenly, and incubation allowed to proceed. The results indicate that the hands of the egg breaker are also a source of infection which, if possible, must be overcome.

Comparison of the Commercial Product with Experimental Samples.

This house did not buy eggs especially for breaking, but used breaking stock sorted from their current receipts. The supply of eggs going to the breaker while the house was under observation was of exceptionally good quality. The bacterial count and chemical analysis of eight samples, including whole egg, yolks and whites, are given in Table 13, Part I. The odor and appearance of all the samples were excellent. The amount of loosely bound nitrogen is low, indicating that, in the shell at least, the eggs were of good quality. But the number of bacteria in the final product shows a wide variation, which can not, apparently, be attributed to the eggs. The minimum count for egg white is less than 1,000, and the maximum is 6,500,000 per gram; the minimum for yolks is 2,000,000 and the maximum is 4,800,000 per gram. The number of presumptive *B. coli* varied from 100 to 100,000 per gram.

An effort was made to eliminate the sources of contamination already described by modifying the equipment and more effectually cleaning the apparatus soiled by eggs that were discarded. Instead of the apparatus in use in this house, there was substituted the breaking outfit pictured and described on page 11 of Circular 98, Bureau of Chemistry, United States Department of Agriculture. Trays holding pails for liquid egg were discarded. Tissue paper was provided on which to dry finger tips. Pails and cans, such as were commonly used, were retained; but all were washed in water at 160° F. and held in that water for five minutes or steamed.

TABLE 13.—*Experimental and commercial samples of whites, yolks, and whole egg. (B house, 1911.)*

Sample No.	Description of sample.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.	Ammoniacal nitrogen (Folin method).		Moisture.	Ether extract.
			20° C.	37° C.			Wet basis.	Dry basis.		
	I.									
	Commercial samples:						*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
436	Whites, from 8-pound pail	Aug. 3	190,000	92,000	10,000	10,000	0.0004			
437	Yolks, from 40-quart can two-thirds full, contents not well mixed	do	4,800,000	4,000,000	10,000		.0029	0.0067	56.86	24.93
438	Whites, from 25-pound pail	do	530,000	420,000	10,000	1,000	.0005			
439	Whole egg, afternoon's leakers broken at end of day	do	3,000,000	2,500,000	1,000		.0013			
441	Whites, from pail	Aug. 4	(1)	(1)	100		.0005			
442	Whites, from pail just filled	do	2,700,000	2,300,000	10,000	1,000	.0005			
443	Yolks, in 40-quart can from Nos. 441 and 442	do	2,000,000	1,200,000	100,000	130,000	.0022	.0071	54.95	26.73
444	Whites, from pail just filled	do	6,500,000	4,100,000	100,000	130,000	.0007			
	II.									
	Experimental samples broken into sterilized apparatus:									
449	Whites of 40 cracks	Aug. 5	(1)	(1)	(1)		.0007			
450	Yolks of above	do	(1)	(1)	(1)		.0034	.0079	56.85	25.44
452	Water drips from Nos. 449 and 450	do	3,000	1,800						
453	Whites, same eggs as Nos. 449 and 450	do	(1)	(1)	100		.0007			
454	Yolks of above	do	(1)	(1)	(1)		.0039	.0087	55.13	26.70
	Commercial sample:									
455	Yolks, from same eggs as Nos. 449, 450, 453, and 454	do	4,300,000	3,500,000	100,000		.0033			
	III.									
	Experimental samples broken into apparatus washed in water at 160° F.:									
463	Whites	do	23,500	19,000	100					
456	Yolks of sample No. 463	do	260,000	180,000	(1)	20,000	.0032			
457	Whites	do	52,000	42,000	(1)		.0008			
458	Yolks of sample No. 457	do	350,000	350,000		25,000	.0033			
462	Drip	do	22,500	11,500	(1)	9,500				
	Commercial samples:									
459	Whites, from pail	do	260,000	270,000	10	200,000	.0007			
460	Yolks, from pail	do	4,100,000	4,200,000	100,000	50,000	.0037	.0087	57.56	25.04
461	Yolks, from 40-quart can	do	1,000,000	820,000	100	20,000	.0031	.0079	60.8	23.10

[1] Less than 1,000.

There were a sufficient number of knives and sherbet cups to permit each soiled piece to be sterilized for fifteen minutes before being again put into service. The apparatus was considered soiled as soon as it had come into contact with an egg that had to be discarded. Current breaking stock furnished the eggs. The results of the laboratory examination of the experimentally prepared product are shown in Part II of Table 13. In order to comprehend their true significance, the bacterial findings obtained must be compared with those found in commercial sample No. 455. The eggs used in these two series were not only from the same lot but from the same cases, the experimental samples coming from one side and the commercial samples being taken from the other, in the routine fashion of the house. Their similarity is further confirmed by the chemical analyses, which are practically identical. The number of bacteria in the experimental samples are uniformly less than 1,000 per gram, and the organisms of the *coli* group are greatly reduced in number, not exceeding 100 per gram, while the corresponding figures for the commercial sample are 4,300,000 bacteria and 100,000 *B. coli*.

Part III of Table 13 gives the results obtained when the equipment was washed and held in hot water at 160° F. before use. When contaminated by a bad egg it was not used again until it had been washed and sterilized. The finger tips were kept dry as before. The number of bacteria per gram is, practically speaking, reduced to a negligible quantity, and the presumptive *coli* organisms are also practically excluded. To emphasize what such cleanliness means the counts should be compared with the commercial samples Nos. 459–461. Here again the bacteria per gram ran over 4,000,000 in the case of the yolks, and the *B. coli* ran as high as 100,000. These eggs, as before, were from the opposite half of the cases furnishing the experimental samples. Such a demonstration, confirmed by many others, showed that the best of eggs, if handled in dirty utensils, would give a product containing many bacteria.

CONDITIONS OBSERVED IN C HOUSE IN 1911.

The equipment used in C house in the preparation of the egg for freezing was also of interest, because it varied in character for almost every breaker. The fancies of the individual girls were more apt to determine the kind of utensils used than any experienced judgment concerning fitness for the work to be done. Sometimes 20 girls were employed, but there was no discipline. The forewoman was the social associate of the girls, and many were the interruptions while town doings were discussed. The whole atmosphere of the breaking room was one of easy-going self satisfaction.

The Breaking Room and Equipment.

The egg-breaking room was long and narrow. Two windows on the outer side wall were screened, as was also the door. The floor was of wood for rather more than half its length, the balance being of concrete and slightly lower in level.

A long table made of wood and covered with zinc stretched from end to end of the room. At this table, facing the light, the girls sat. About 18 inches above the table and running along the wall and across the windows was a galvanized-iron gutter about 5 inches in diameter and about 2 inches deep. Over this were water faucets so placed that they could be reached without the girls leaving their seats, and in this stream of cold water the girls rinsed fingers and utensils. About half way down the room, breaking the table line, was a wooden trough supplied with hot and cold water and used for the general cleaning and washing.

At the two ends of the room were large galvanized-iron cans, supplied with stirrers and creamery faucets and called churns. In these the eggs were mixed before being put into their final carriers.

The girls were using heavy walled glass tumblers, tin cups, agateware cups, sherbet glasses, and ordinary china teacups, depending entirely upon the preference of the worker and the receptacle available. Each girl had a small tray—tin, agate, or black japanned ware—on which she placed the egg receptacles. She also had a group of agateware buckets, holding about 3 quarts each, into which she emptied her smaller receivers. These buckets were dumped into the churns, or, in the case of egg white, directly into 30-pound pails, in which they were frozen. When the study of C house was made it was putting out egg white, egg yolk (sugared and unsugared), and a first, second, and third grade of whole egg. The third grade was known as "tanners'," and was not for food purposes.

Routine of Egg Breaking.

All the eggs coming to the breaking room were candled, but the candlers were apt to put in doubtful eggs for the breakers to grade, rather than take the time and trouble to decide in the candling room whether they were or were not fit for food. All the eggs were chilled, but the breaking room was not, hence there was a profuse sweating of shells during much of the egg-breaking season.

The girls removed the fillers and flats, layer by layer, as they reached them, and took several eggs at one time, holding them in the right hand, and pushing up one at a time for shell cracking and emptying. Of course, dirty eggs, sweating also, immediately resulted in badly soiled hands. The eggs were cracked on the edge of a cup, glass, or whatever type of receptacle the breaker happened to have. Generally, it was not suited to cracking an egg because it mashed and splintered the shells instead of making a clean cut. Having cracked the shell, the girl was supposed to hold it over the glass and determine, by the appearance of the egg at the crack, whether it could or could not be separated into white and yolk, or to which grade of egg it belonged. If it could be separated, the white was drained off, housewife fashion, into one receptacle, and the yolk dropped into another. If the egg was too "soft" to separate, but odorless, it went into first-grade whole eggs. If it was a little "off," or "strong," or a "beginning sour," it went into second-grade whole eggs. The tanners' egg was composed of white rots, which were not too malodorous, musty eggs, moldy eggs, eggs with a bloody white, and blood-ring eggs.

The forewoman gave some instructions regarding the grading of eggs by appearance, odor, taste, etc. In practice, every girl graded according to her own sweet will. Hence, the output of the different breakers was very uneven. In the long run, judging by observation, about as many firsts went into seconds as there were seconds put into firsts.

When some of the egg yolk, during the process of separation, ran into the tumbler of egg white, it was fished out by means of a spoon, or, more commonly, by a piece of egg shell. If an objectionable yolk got into the yolk cup, or some of a bad egg into a food-egg grade, the entire contents of the receptacle was supposed to go into the bucket indicated by the character of the egg last entering. In practice, however, the breaker used a spoon or an egg shell to take out as much of the objectionable egg as she could see and quite disregarded its presence when grading. The remnants left were a fine source of contamination and foci for bacterial troubles later on. The girls in C house used cups and tumblers large enough to hold from 6 to 10 eggs. Many times it was the last egg required to fill the vessel that was off grade. The instinctive desire on the part of the breaker to procure as much high-grade product for her employer as possible, and her reluctance to swell the amount in her tanners' bucket, will override all instructions forbidding the removal of objectionable eggs as just described. The only way to overcome the habit is to have the first receiver so small that it cannot accommodate more than two or three eggs.

Cleanliness.

The problem of cleanliness assumed a different aspect in C house, because of the running cold water to which every girl had easy access. Laboratory methods were called in to determine the efficacy of frequent rinsing in cold water with the supplementary cleaning in hot water twice a day in removing the bacteria of the objectionable egg, or other dirt, from hands and utensils.

At noontime, after the usual cleaning in hot water, a number of the cups, tumblers, etc., were tested for bacterial contamination. In every case, abundant evidence of insufficient cleansing was observed. Plate II, figure 1, shows the growth resulting when the edge of a tumbler was just touched against a sterile agar film on a petri plate.

To gain some idea of the number of organisms adhering to the vessels, a drop of water from each of a number of tumblers was plated as is customary when colonies are to be counted. A glass which had received yolks gave an average of 630 organisms to the drop; one that had been used for whites gave 570; the glass that had received the tanners' egg gave 5,900 per drop. That the pails into which the eggs were first emptied were prolific carriers of organisms was also proved. Plating in this case gave 2,600,000 per cc, equivalent to 20 drops. That more bacteria would adhere to the agateware pails than to china or glass cups was to be expected, because of the greater roughness of the former.

It was desirable, also, to determine to what extent the fingers of these girls passed on the bacteria of rejected eggs to those that had but few. Plate II, figure 2, shows

the number of colonies which developed when a sterile petri plate was touched with the tips of five fingers that had just been washed because they were wet with egg—but not with objectionable egg. For comparison with this, Plate 11, figure 3, is given. Here we have the result of breaking a tanners' egg. Even though the hands were washed in running cold water, the mere touch of finger tips gave so many colonies that they were innumerable.

The lessons here are quite plain. First, ordinary washing of either hands or utensils is not sufficient to keep them, bacterially, fit for egg breaking; and, second, when bad eggs, unfit for food, are broken the removal of the hordes of bacteria which they carry becomes an extremely difficult task.

Comparison of the Commercial Product with Experimental Samples.

A number of samples of the product of C house were taken during the months of July and August, 1911. The bacterial content of the whites were, on the whole, the lowest; yolk was considerably higher, and the whole egg the highest. The greater number of the routine samples of whole egg were of the second grade. (See Table C–I, Appendix, p. 64.) It will also be seen that some of the so-called second-grade egg is of quite as good, if not better, quality than the first grade—a result which was to be expected from the loose methods of grading.

The glass cups, adjustable knives, and wire-screened tray, described on page 11 of Circular 98, were taken to C house in order to determine the character of the eggs used as indicated by cleanly methods of handling. A supply of live steam in a near-by creamery was utilized to sterilize the apparatus. Part I of Table 14 shows the results obtained from eggs with cracked shells, when sterilized apparatus was used, and, under "Commercial samples" are shown similar eggs broken in very cleanly fashion in the apparatus belonging to the house. The second-grade, commercial, whole egg is decidedly richer in organisms than is the first-grade whole egg (9,200,000 in one case and 4,900,000 in the other), but because the number of samples is so small but little stress can be laid on the findings. The higher bacterial count for the first-grade whole egg of the experimental samples is probably due to the fact that soft eggs without bad odor but which would not separate were used—an interesting side light on the results of errors in grading. Considering the whites and yolks only, the count of the commercial samples varied from 310,000 per gram in the white to 1,600,000 in the yolk, as compared with 810,000 and 770,000 in the experimental series. When the experiment was repeated, using seconds with sound shells instead of cracked eggs, all the bacterial counts were decidedly lower.

TABLE 14.—*Experimental and commercial samples of whites, yolks, and whole egg (C house, 1911).*[1]

Sample No.	Description of sample.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.	Ammoniacal nitrogen (Folin method).		Moisture.	Ether extract.
			20° C.	37° C.			Wet basis.	Dry basis.		
	I.									
	Experimental samples broken into apparatus steamed 15 minutes (cracked eggs):									
	First grade—						*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
578	Whites	Aug. 22	810,000	710,000	100	.....	0.0002	.....	.....	.....
579	Yolks	do	770,000	480,000	1,000	350,000	.0026	.....	.....	.....
576	Whole egg	do	1,200,000	1,200,000	(2)	.....	.0015	.....	.....	.....
	Second grade—									
577	Whole egg	do	8,500	13,000	1,000	.....	.0017	.....	.....	.....
	Tanners' grade—									
581	Whole egg	do	64,000,000	55,000,000	1,000,000	28,000,000	.0015	0.0062	74.03	10.64
	Commercial samples:									
	First grade—									
573	Whites	do	310,000	400,000	10,000	200,000	.0002	.....	.....	.....
574	Yolks	do	1,600,000	1,400,000	1,000,000	210,000	.0028	.....	.....	.....
580	Whole egg	do	4,900,000	4,900,000	100,000	260,000	.0018	.....	.....	.....
	Second grade—									
575	Whole egg	Aug. 8	9,200,000	8,500,000	100,000,000	1,000,000	.0020	.....	.....	.....
	II.									
	Experimental samples broken into apparatus steamed 15 minutes (seconds—whole shells):									
	First grade—									
602	Whites, 15 dozen	Aug. 22	6,000	2,000	100	.....	.0002	.....	.....	.....
603	Yolks, 15 dozen	do	27,500	22,500	100	.....	.0024	.....	.....	.....
605	Whole egg, 15 dozen	do	.....	15,500	1,000	.....	.....	.....	.....	.....
	Second grade—									
604	Whole egg, 15 dozen	Aug. 8	6,300,000	6,000,000	1,000,000	2,400,000	.....	.....	.....	.....

[1] Apparatus: Sherbet cups, 2-quart agateware buckets, new breaking tray, glass rod to mix, 30-pound cans for permanent containers.
[2] 0 in 1:10,000.

CONDITIONS OBSERVED IN E HOUSE DURING TWO CONSECUTIVE YEARS.

Season of 1911.

This firm erected a building a few years ago especially to put up evaporated eggs. Refrigeration was installed, but the business soon outgrew the supply. However, the eggs were put into the chill room as soon as received, and usually they were candled 24 hours later.

THE BREAKING ROOM.

The room in which the eggs were broken was about 75 feet long, 27 feet wide, and 11 feet high, and was on the second floor. It opened at one end into a room where the finished product was being put into packages and at the other into a small room where the liquid egg was held in a creamery tank, cooled by a brine-chilled stirring machine until it was needed to replenish the supply going to the drying belts. The temperature in the drying room was often 110° F. or more. Wood partitions separated the drying from the breaking room; hence it was impossible to keep the latter cool.

The outer wall of the breaking room was brick; the partition walls were of wood. A row of windows, high up, were always wide open for light and air. The ceiling was high, and with open beams. The floors had calked seams, such as are used in meat-packing houses. The breaking room is pictured in Plate IV.

At one end of the room was a long sink with hot and cold water, where all the utensils were washed. Tables extended along each side of the room. These were covered with zinc and supported the cases of eggs and individual breaking equipment. The eggs were broken on an apparatus (Pl. IX, fig. 2) consisting of a wedge-shaped knife supported on a half-inch iron pipe which was screwed by a flange to the table top. A funnel-shaped metal collar surrounded the knife and discharged the leakage from the eggs into the shell tubs. This collar was added late in the season and served to keep tables and floors far cleaner than they had previously been. There was still, however, a great waste of egg from leakage.

The girls broke from 13 to 24 eggs a minute. As it is impossible to grade at this rate, good eggs were sometimes discarded and bad eggs were sometimes used.

The number of bad eggs going to the breakers was unnecessarily increased because the candling was not accurate. The candlers simply "flashed" eggs in front of the light and threw them, pell-mell, into the cases, so that a large number of eggs with sound shells were made into cracked eggs and those with cracked shells were wrecked. The extra work and unnecessary loss that such poor candling entailed in the breaking room was shown, for example, by one breaker who found 9 bad eggs in one case. These she threw away and with them 24 good ones. She also made nine trips the entire length of the room, to get clean pans, since instructions were to take a pan to be washed after it had received a tanners' egg.

The liquid egg was collected in buckets. Those, in turn, were emptied into a large churn through a wire screen. Rubber hose led from the churn to the long creamery tank before mentioned. This hose was dirty and could not be cleaned. It was replaced by sanitary piping, which permitted of sterilization in every part, just as soon as the actual condition of the rubber hose was made known to the management.

From the tanks the egg was led by a gate valve into buckets; the buckets were carried to galvanized-iron tanks which supplied the feeding trough of drying machines of the belt type. The belt was constructed in the usual way. The temperature was about 160° F., and the time required was from one to one and one-half hours for one run. Flaky egg was the result. It was put up generally in barrels, or in small tin cans, for household use. Two grades were made—one for food purposes, the other for tanning leather.

SOURCES OF BACTERIAL CONTAMINATION.

Observation would indicate that the method of cleaning utensils in use in E house failed to cleanse, bacteriologically speaking. The facts that the laboratory revealed are indicated in Plate III, figures 1, 2, and 3. The importance of the findings in relation to the bacterial content of the product is emphasized by the fact that the tests were made at noontime, when an especially thorough washing was given to insure cleanliness during the afternoon.

The breakers paid no attention to cleanliness of hands, so far as the egg itself was concerned. Their hands were constantly wet with good egg, and bad and dirty shells were handled regardlessly.

Touching the tips of such fingers very lightly against a petri plate containing agar showed that their hands were far from clean, as is seen in Plate III, figure 4. The growth on the plate itself was shown the girls and was a revelation to them.

The lack of knowledge of the fundamentals of bacterial cleanliness is perfectly apparent from the efforts of the management to conduct their business in a cleanly fashion. The other appliances coming in contact with the liquid egg were just as ill suited, bacteriologically speaking, to the work they had to do, yet every effort was being made, so far as the knowledge of those in charge went, to throw away bad eggs and to put out only a high-class product.

COMPARISON OF COMMERCIAL PRODUCT WITH EXPERIMENTAL SAMPLES.

Table 15 gives the laboratory findings on the liquid egg prepared under the conditions just described. The minimum number of organisms obtained was 3,300,000 per gram; the maximum was 23,000,000. The number of gas producers in lactose bile medium ran from 100,000 to at least 1,000,000. In many cases these results are too low, because dilutions were not made in sufficient number to estimate higher counts. The loosely bound nitrogen, calculated on the fresh material, was from 0.0020 to 0.0030 per cent.

All these samples were intended for human food. The tanners' egg which was being made is shown in samples Nos. 327 and 484. There is a noteworthy leap upward in both bacterial content and loosely bound nitrogen.

This series of examinations in Table 15 does more than give the condition of the final product in that it illustrates to a certain extent how the organisms increased as the egg went from one container to another. The first of each of the paired examinations represents egg which had been in contact with the hands of the breaker, the knife blade, the little agateware pan, and the agateware bucket. The second sample represents the same egg after it had been strained, thoroughly churned to mix white and yolk, and allowed to pass through the rubber hose for storage in the large tank.

Part II of Table 15 traces the liquid egg from the storage tank to the drying belt and gives the final outcome after all the manipulations. During the drying process the water content of the liquid egg is reduced to one-third or less of its original amount. Likewise the number of organisms is reduced, though not in such marked proportion. It must be remembered that bakers dissolve this dried egg in water; hence, on the liquid basis it would have only about one-third as many organisms per gram as are shown on the dry basis. The lowest bacterial count for the dried egg was found to be 3,700,000, the highest 17,000,000, with an average of 9,200,000 per gram. The loosely bound nitrogen in the dried product is considerably less than in the liquid egg. Undoubtedly some of this form of nitrogen is driven off by the heat and aeration in the process of drying; therefore this substance can not be taken as an index of quality on the same basis as in the liquid product.

In order to determine the effect of breaking the same eggs that were being used in E house, in what might be termed an approximately bacterially clean fashion, the experiments reported in Table 16 were made. The apparatus used for this purpose was that described on page 27. It was cleaned by washing in running water, then heated in a steam box for 20 minutes. The technique of breaking was as given on page 23 for B house. The results are given as samples Nos. 485 and 486 in Table 16, cracked and dirty eggs. Samples Nos. 489 and 503 were from the same lots of eggs, but were broken by one of the women in the regular fashion. The difference in bacterial content is astonishing (11,000,000 in the commercial product as compared with less than 1,000 bacteria in the experimental samples in the case of dirty eggs), but the loosely bound nitrogen is practically the same, indicating about the same amount of aging in the shell.

Sample No. 488 (clean eggs) was broken by the same operator who prepared the other experimental samples, but in this case the usual equipment of the house was used and the work was done as nearly as possible as the regular breakers did it. It may be compared with sample No. 487, which was taken from the same lot of eggs and was the work of an egg breaker employed in E house. It will be seen that like equipment and methods produced like results, whether the operator was an egg breaker or a bacteriologist.

TABLE 15.—*Commercial samples of liquid and dried eggs (E house, 1911).*

Sample No.	Description of samples.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram (000 omitted).	Ammoniacal nitrogen (Folin method).		Moisture.	Ether extract.
			20° C.	37° C.			Wet basis.	Dry basis.		
	I.									
	Liquid whole egg before drying:						*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
298	From 3 pails before going to first tank	July 20	7,600,000	6,000,000	100,000	220	0.0026			
299	From hose entering large tank	do	11,000,000	9,900,000	100,000	200	.0026			
300	From 3 pails				100,000+		.0025			
301	From hose entering large tank	July 20	5,300,000	4,600,000	100,000+	150	.0025			
302	From 3 pails	do	2,600,000	3,300,000	100,000+	80	.0023			
303	From hose entering large tank	do	7,700,000	6,200,000	100,000+	120	.0020			
477	Liquid egg from 3 pails before straining	Aug. 7		9,400,000	1,000,000	170	.0025			
478	No. 477, from hose entering large tank	do	15,000,000	14,000,000	1,000,000+	350	.0026			
479	From 3 pails before straining	do	7,300,000	6,500,000	1,000,000	95	.0028			
480	No. 479, from hose entering large tank	do	12,000,000	11,000,000	100,000+	50	.0022			
501	From 3 pails before straining	Aug. 8	9,100,000	8,200,000	1,000,000		.0028			
502	No. 501, from hose going to large tank	do	13,000,000	7,800,000	1,000,000+		.0030			
504	From 3 pails before straining	Aug. 9	12,000,000	7,700,000	1,000,000+		.0029			
505	Do	do	16,000,000	12,000,000	100,000+		.0029			
506	From hose entering large tank	do	23,000,000	12,000,000	1,000,000+		.0025			
	II.									
	Whole eggs before and after drying:									
304	From 6 pails from large tank going to reservoir of belt No. 4	July 20	8,600,000	7,200,000	100,000+	900	.0023			
325	Dried egg from belt No. 4 (11 a. m.)	do	7,100,000	3,500,000	1,000,000	250	.0022	0.0024	7.40	37.12
326	Dried egg from belt No. 4 (3 p. m.)	do	8,800,000	3,500,000	1,000+	2,700	.0014	.0015	6.50	37.69
305	From 6 pails from large tank going to reservoir of belt No. 2	do	13,000,000	8,300,000	100,000+		.0021			
323	Dried egg from belt No. 2	do	5,900,000	5,000,000	1,000,000	450	.0016	.0017	7.83	36.77
481	From tank for belt No. 2	do	12,000,000	11,000,000	1,000,000+	700	.0022			
490	Dried egg from belt No. 2	do	8,900,000	7,800,000	1,000,000				6.24	37.45
482	From tank for belt No. 4	do	14,000,000	13,000,000	1,000,000+	3,500	.0023			
491	Dried egg from belt No. 4	do	12,000,000	6,000,000	1,000,000+	700	.0013	.0014	6.94	37.57
483	From tank for belt No. 1	do	14,000,000	8,000,000	1,000,000+	3,000	.0022			
493	Dried egg from belt No. 1	do	17,000,000	15,000,000	1,000,000+	3,500	.0025	.0028	9.23	36.34
	III.									
	Dried whole egg:									
322	From belt No. 1	July 20	11,000,000	11,000,000	1,000,000+	270	.0017	.0018	7.68	36.66
324	From belt No. 3	do	3,700,000	3,100,000	100,000+	290	.0016	.0017	8.50	36.42
492	From belt No. 5	Aug. 8	10,000,000	5,800,000	1,000,000	4,000	.0018	.0020	7.09	37.23
494	1 year old	do	7,600,000	3,500,000	10,000+	100				

TABLE 15.—*Commercial samples of liquid and dried eggs (E house, 1911)*—Continued.

Sample No.	Description of samples.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram (000 omitted).	Ammoniacal nitrogen (Folin method).		Moisture.	Ether extract.
			20° C.	37° C.			Wet basis.	Dry basis.		
	IV.									
	Tanners' egg:						*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Liquid egg—									
306	From supply tank on way to belt No. 5	July 20	110,000,000	220,000,000	100,000+	.....	0.0057	0.0091	.....	.....
484	Spots and leakers	Aug. 7	.....	150,000,000	1,000,000+	5,000	.0043	.0117	.....	.....
	Dried egg—									
327	From belt No. 5	July 20	84,000,000	4,600,000	1,000,000+	4,000	.....	.....	.....	31.50

TABLE 16.—*Experimental and commercial samples of whole egg (E house, 1911).*

Sample No.	Description of sample.	Date of collection.	Bacteria per gram on plain agar at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.	Ammoniacal nitrogen (Folin method, wet basis).
			20° C.	37° C.			
	Experimental samples of whole egg:						*Per cent.*
485	Cracked eggs	Aug. 8	42,000	25,000	1,000	.....	0.0028
486	Dirty eggs	...do.....	(1)	(1)	1,000	.....	.0028
	Commercial samples:						
487	Clean eggs	...do.....	5,700,000	4,100,000	1,000	600,000	.0030
488	Clean eggs	...do.....	5,400,000	5,100,000	.....	50,000	.0026
489	Dirty eggs	...do.....	11,000,000	7,800,000	(1)	300,000	.0026
503	Commerical breaking stock	...do.....	8,600,000	6,100,000	1,000,000	300,000	.0028

[1] Less than 1,000.

Season of 1912, After Remodeling.

This plant was practically rebuilt so far as the space used for candling, breaking, and storage of eggs was concerned. All the rooms involved in handling the eggs from their receipt until they went to the drying machine were refrigerated.

The increased supply of refrigeration was used to chill all incoming eggs at least 24 hours before candling; to keep the candling room at about 55° F.; to maintain a temperature of 60° F. in the breaking room; to keep the liquid egg at a temperature below 40° F. while holding it to supply the drying machines; and, finally, to freeze the liquid egg, if it was to go into commerce hard frozen.

CONSTRUCTION.

Breaking room.—The construction of the breaking room was materially changed. It was insulated with 2 inches of cork and was of reinforced concrete construction except the ceiling, which consisted of two layers of tongued-and-grooved 3-inch boards. The windows were closed with four panes of glass for insulation, with a prism glass on the outside to evenly distribute the light. The walls and ceiling were finished with white waterproof enamel. The wash room was separate from the breaking room, and a vestibule protected the latter from atmospheric temperatures. The creamery tank was in the opposite end of the breaking room and was not partitioned off. Brine pipes fastened to the ceiling and an incoming supply of chilled air furnished the necessary refrigeration and ventilation. The general appearance of the room is shown in Plates V and VI.

Wash room.—The room in which the cleansing and sterilizing of the egg-breaking apparatus was performed was also of cement construction, well lighted and with floor drains. (Pl. XI, fig. 1.)

Freezer.—The freezer was constructed with brine-pipe racks on which the cans of liquid egg were set. These racks, through which the brine circulated, greatly expedited the freezing of the egg. (Pl. XIII, fig. 1.)

Candling room.—The candles, which had two holes, were remodeled so that the oval openings against which the eggs rested were of such a size and the edges so beveled that the egg entirely closed the space. A tungsten electric bulb was placed behind each hole. As the eggs were graded they were placed in galvanized-iron buckets holding 12 dozen each. In the bottom of each bucket was a woven-wire screen supported by a 1-inch galvanized-iron rim. The eggs rested on this screen, which served as a cushion, so lessening breakage and offering a protection from the leakage which might collect in the bottom of the pail. The outfit of one candler is shown in Plate IX, figure 1.

When filled, the buckets were transported to the breaking room on a mechanical carrier, consisting of two endless belts connected by crossbars on which the buckets hung by loose hooks, so that they were always upright. This arrangement obviated the necessity of taking trucks into the breaking room.

EQUIPMENT.

Breaking room.—The tables used in the breaking room were covered with zinc and were supported on legs of galvanized-iron pipe. (Pls. V and VI and Pl. IX, fig. 3.) No wood was exposed. Four holes, about 5 inches in diameter, were placed at equal distances along the middle of the table. Into these holes galvanized-iron funnels were fitted, and served to conduct the shells into the galvanized-iron tubs which were set below them on the floor. One such funnel was used by two breakers. On the end of the table a frame, constructed of galvanized-iron pipe, was used to support the trays which held the sterilized cups and breaking knives. Under this tray, on the table itself, was a second tray used to collect the soiled apparatus. (Pl. V.)

The breaking outfit consisted of a rectangular cast-iron base into which were soldered two uprights, one of which terminated in a ring to hold the cup, the other in a flat plate with two buttons for holding the breaking knife. This knife was about 4 inches long and about 1 inch wide. A white enameled pan rested on the base to catch the liquid egg which dropped off the breaking knife. The cup used was of annealed glass with a smooth surface inside and out and held four eggs. The construction, in detail, of this breaking equipment is shown in figure 6. The eggs were emptied from the shells into the cups, which were, in turn, emptied into a 12-quart enameled pail.

A galvanized-iron box for holding the tissue paper used for drying fingers is shown in Plate IX, figure 3. These boxes were hung on the pails containing the shell eggs.

Wash room.—The wash room (Pl. XI, fig. 1) was equipped with metal throughout. It contained two round-bottomed sinks, two sterilizers, and gas-pipe shelves to hold pails, trays, etc., after sterilization. The sinks were supplied with an abundance of hot and cold water.

The sterilizers were built of galvanized iron in two compartments, and had shelves formed of perforated pipes which supplied the steam. A flue from the top of the box was connected with a damper and a fan in order to remove the steam quickly after the sterilization was finished. A thermometer, especially constructed for such work, was a necessary part of the apparatus. One sterilizer was used for cups exclusively and was supplied with wire-bottomed trays which rested on the steam pipes and were made to fit the space. The other sterilizer was used for buckets, shell tubs, and other bulky equipment. An auxiliary wash room with a sink and a sterilizer was a part of the drying-room equipment.

CONDITIONS PREVAILING EVERY THIRD WEEK FROM APRIL TO SEPTEMBER.

Visit No. 1 (April 22 to 27).

There were seven visits of one week each made to E house during the season of 1912. At the time of the first visit the refrigerating machinery was not in operation, but the temperature in the candling room and the breaking room was from 60° F. to 65° F., due to the cool weather. Steam was plentiful and the sterilizers and wash room were in operation. The breaking room had the equipment already described, with the exception of the new breaking outfit. A makeshift was used while waiting until the new forms of apparatus arrived. It was sloppy; therefore, the girls were forced to use cloths to wipe tables, cups, hands, and, sometimes, the floor. These rags were always wet and always unsightly. A bacterial examination of the water squeezed from 12 of them showed that they were carrying germs to the number of 150,000,000 to each cubic centimeter. Until the improved apparatus was obtained it was decided to substitute clean pieces of cheesecloth for the indiscriminate rags and to wash and sterilize them twice daily. The breakers were provided with clean white gowns and caps. Each girl was given a clean towel every morning.

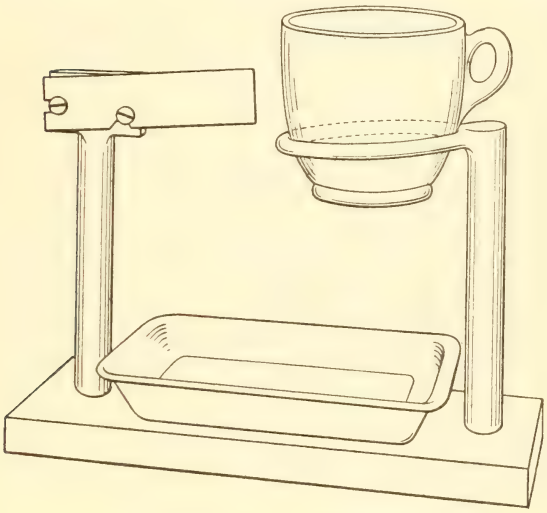

FIG. 6.—Egg-breaking outfit (E house, 1912).

All apparatus which came in contact with the egg was sterilized after washing, and laboratory tests showed that it was free from bacteria, with the exception of the troughs and brushes used to feed and spread the egg on the drying belt. This difficulty was partially corrected by lengthening the period of steaming, and plans were made to obtain a duplicate set of these devices to permit of sterilizing after each run.

The supply of eggs.—During this period the egg supply of this house consisted of dirty and cracked eggs sorted by other firms from lots going into storage. It was the custom in this house to candle all incoming stock, regardless of the season. The candlers found a sufficiently large number of incubator rots to warrant this extra grading before submitting the eggs to the breakers. At this season the eggs were purchased on the "case-count" basis.

Breaking-room routine.—There were employed at this time 15 girls, with an average output of 14 cases per girl per day of 10 hours. Very few of these girls had been egg breakers. It was deemed best to instruct from the start rather than to remodel objectionable fixed habits. A foreman accustomed to ruling girls, but ignorant of the business of egg breaking, was in charge.

The girls were drilled in the essentials of bacterial cleanliness as well as in the grading of the eggs. They were instructed to wash their hands after a bad egg and to dry them before returning to work. While working, fingers were to be kept dry by means of tissue paper. The aim, however, was so to handle the eggs that the

fingers did not become wet. Inexperienced or inefficient breakers always have wet hands. The instructions regarding clean, dry hands were illustrated by making finger prints on agar plates. The bacterial growth resulting was especially useful in showing the breakers the persistence of the organisms characterizing green white eggs, which were plentiful at this time. The routine of cracking, turning, opening, and draining the shells was that described when discussing D house in 1912 (p. 58).

Eggs at this time cost 18 cents per dozen. It was necessary, therefore, to prevent waste as far as possible. Constant supervision enforced the regulation to turn the eggs upward quickly after cutting to prevent leakage, and to hold the two halves of the shell long enough to drain thoroughly. Another form of waste was due to the fact that 4 eggs were put into the cup before emptying; therefore 3 good eggs were sometimes lost because of 1 bad one. The management feared that too much time would be lost if the girls emptied the cups after each 3 eggs instead of 4. Observations made with a split second timer showed that it required 26 seconds longer to open a dozen eggs when breaking 3 instead of 4 eggs to a cup before emptying. By interpolation, this difference amounts, on a case basis, to only 1.3 minutes. This extra time was considered negligible when compared with the number of good eggs saved if the cup was emptied when it contained 3 eggs.

Other observations made amply confirm the foregoing statement. For example, during one-half day, there came to the breaking room 195 bad eggs. These were mixed by the breakers, when breaking 4 eggs to the cup, with 301 good eggs, which were, of course, discarded. At 18 cents a dozen this loss, during one-half day, amounted to $4.50. It would seem desirable, to prevent waste and contamination as well as to insure good grading, to work toward means by which each egg shall be handled separately.

TABLE 17.—*Contamination of good eggs with green-white eggs (E house, 1912). (Commercially prepared in packing house by breaking 4 eggs per cup and endeavoring to "pour off" the bad egg.)*

Sample No.	Visit.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.	Size of sample.
			20° C.	37° C.			
4166	E 1	Apr. 22	26,000,000	750,000	10,000	.....	2 quarts.
4271	D 1	May 7	1,200,000	500,000	10,000	0 in 10,000	4 eggs.
4280	D 1	May 8	4,200,000	39,000	10	530,000	Do.
4305	E 2	May 13	35,000,000	22,000,000	1,000,000	4,700,000	8 eggs.
4319	E 2	May 14	14,000,000	15,000,000	10,000	15,000,000	
4327	E 2	May 15	7,800,000	500,000	100	5,500,000	5 eggs.
4341	E 2	May 17	9,700,000	1,300,000	0 in 10,000	6,100,000	7 eggs.

It is not possible to separate the undesirable from the desirable egg by pouring out of the cup the visible undesirable egg. This fact is illustrated by experiments grouped in Table 17. When an egg with a green white was received in a cup already holding one or more good eggs, the green-white egg was poured off and the eggs remaining were collected and examined. The bacterial findings, as given in Table 17, show that the bacteria from the green eggs contaminated the good eggs, the extent of which is brought out by comparing the counts of the commercial product of the house made at the same time as the experiments under consideration. It was against the rules of the breaking room to use any liquid egg out of the shell which had been in contact with a bad egg. The bacterial variation in the regular product was from 140,000 to 1,500,000 per gram; the lowest finding for the good eggs in contact with a green-white egg was 1,200,000, and the maximum was 35,000,000. This principle holds true for any highly infected egg in contact with a good egg, and effectually disposes of the habit of pouring out the visible portions of the bad egg and using the rest.

The product.—Two series of experiments were made on different days, tracing the egg step by step from the first pail to the final dried product. The results of these experiments, as listed in Table E–I (Appendix, p. 66), under visit No. 1, showed that the sources of contamination existing in 1911 had been eliminated except in one instance—namely, the brushes used to spread the egg on the drying belt. Even here the total count did not rise, but there was an appreciable increase in the number of *B. coli*. There is a discrepancy in the number of bacteria reported in this sequence of samples. This is due, probably, to the fact that they were taken at the outset of the work before the routine of taking and handling samples was established. Too much

reliance can not, therefore, be placed on them, but they do serve to show a trend which is later confirmed when the same criticisms of technic can not be made.

The eight samples of liquid whole egg to determine progressive contamination had a variation in bacterial count ranging from 140,000 organisms per gram to 1,500,000 and in the number of *B. coli* from 0 to 10,000.

The final dried products of the two series of experiments had, as listed in Table E–I (Appendix, p. 66), under samples Nos. 4177 and 4191, a count of 1,300,000 in the first case and 430,000 per gram in the second. The number of *B. coli* in sample No. 4177, before and after drying, was 1,000 per gram; in No. 4191, 10,000 per gram before drying and none afterwards. They had probably been killed by heat during desiccation. Three other samples of dried egg taken during this period had bacterial contents similar to specimen No. 4177.

Immediately after the desiccated egg was scraped from the belt it was sifted to break up the flakes and to separate out the wet lumps. (See p. 15.) To insure thorough drying, the screened egg was placed in a bin at a temperature of 100° F. for a few hours. Determination of moisture in the flaky egg before and after this secondary drying showed practically no change in the water content.

The wet lumps were rubbed through a sieve with the hands or by means of a grooved block of wood about 4 inches square and placed in a bin at about 100° F. for final drying. The wet lumps sifted from the same run as the dried egg described under No. 4191 had, as shown in Table E–II (Appendix, p. 68), 14,000,000 bacteria per gram and a moisture content of 18 per cent, both of which are distinctly higher than the corresponding flaky portion. Other samples of wet lumps taken before and after sifting, and after secondary drying, had bacterial counts of 2,400,000, 2,100,000, and 3,300,000 per gram respectively. The moisture content was reduced from 17.40 to 6.94 per cent by secondary drying.

Visit No. 2 (May 13 to 18).

The refrigerating had not been completed, and the new breaking outfits had not arrived. Since the former visit an extra set of brushes had been made for each drying belt, so that it was possible to have them changed between runs. They were always steamed for an hour instead of 20 minutes. An extra set of feeding troughs were in the process of making. Duplicate parts of the mixing device had been purchased so that one set could be washed and sterilized while the other was in operation.

The breaking stock of this period consisted of about 235 cases of cracked eggs per day. Grading the eggs before the candle was being done well. The work in the breaking room was also good when the number of untrained girls and the makeshift apparatus are taken into consideration.

It was customary for the girls to break enough eggs in the afternoon to cover the belts during the first run in the morning. The weather was so warm that there was bacterial multiplication in the liquid product while being held overnight without refrigeration, as may be seen from the bacterial contents of the corresponding dried products, given in Table 18.

TABLE 18.—*Effect of lack of refrigeration of liquid stock upon bacterial content of dried product (E house, 1912).*

COMMERCIAL SAMPLES OF DRIED EGG PREPARED FROM LIQUID EGG HELD AT ROOM TEMPERATURE OVER NIGHT.

Sample No.	Visit.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.
			20° C.	37° C.		
4295	2	May 1	9,200,000	5,000,000	100,000	300,000
4296	2	May 3	15,000,000	11,000,000	10,000	0 in 10,000
4431	3	May 21	5,300,000	1,300,000	10,000	20,000
4432	3	May 23	7,100,000	1,400,000	10,000	20,000
COMMERCIAL SAMPLES OF DRIED EGG PREPARED FROM LIQUID EGG IMMEDIATELY AFTER BREAKING.						
4297	2	May 6	1,100,000	900,000	10,000	70,000
4298	2	May 8	900,000	550,000	10,000	0 in 10,000

Six samples of desiccated egg taken on this visit showed from 65,000 to 13,000,000 organisms to the gram, as tabulated in Table E–III and E–V (Appendix, pp. 70 and 74), under visit No. 2.

A study of the dried product of four different runs showed, as expressed in Table E–II (Appendix, p. 68), under visit No. 2, that the wet lumps in every case had a higher bacterial content than the flaky egg. In some samples this difference was negligible; in others it was marked. The moisture content of the wet lumps varied from 16.46 to 21.68 per cent.

TABLE 19.—*Commercial samples of liquid and dried tanners' egg (E house, 1912).*

Sample No.	Description of sample.	Date of sampling.	Visit.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.	Ammoniacal nitrogen (Folin method).		Moisture.
				20° C.	37° C.			Wet basis.	Dry basis.	
								P. ct.	*P. ct.*	*P. ct.*
4195	Liquid egg.....	Apr. 26	1	100,000,000	17,000,000	1,000,000+	.....	0.0069	0.0219	68.53
4323	Dried egg.....	May 14	2	20,000,000	4,700,000	100,000+	1,200,000	.0024	.0025	5.54
4347	.....do.....	May 17	2	48,000,000	4,800,000	10,000+	2,600,000	.0020	.0021	6.90
4348	Liquid egg.....	...do....	2	130,000,000	24,000,000	1,000,000+	.....	.0041	.0146	71.89

During this visit two samples of liquid and two of dried tanners' egg were taken. The laboratory results given in Table 19 showed, as would be expected, an excessive number of bacteria and large quantities of ammoniacal nitrogen.

Visit No. 3 (June 1 to 5).

The third trip to this house was made when most of the new equipment for the season was in operation. The extra set of supply troughs to the drying belts had been made; two creamery tanks, with a capacity of 800 gallons each, were installed; the new breaking outfits were in use; and, most important of all, there was a plentiful supply of refrigeration, so that the eggs could be kept cold from time of receipt until the liquid was spread on the drying belts.

Each tank had a continuously revolving brine coil, which served to keep the egg at a temperature just above freezing until it was drawn off to be dried. These creamery tanks were especially constructed in that the lids were perforated to permit of the steam hose being inserted, and the joints were tight enough and strong enough to hold the steam. A temperature of 210° F. was readily maintained for one-half hour. Of course, the cold brine was emptied from the pipes before the steam was admitted.

With the accession of refrigeration the receipts had been doubled, so that the drying room was in operation day and night. The force had been increased so that all the eggs were candled and broken during the day. The egg supply consisted of "dirties" and "checks," about half and half.

The work of the candlers was fair; the work in the breaking room, however, was very unsatisfactory because the forewoman was not enforcing the routine decided upon. The girls, for instance, were only occasionally washing hands and changing knives after bad eggs. Their manipulation of the new breaking outfit was an example of how poorly a good piece of apparatus can be used. They gave the eggs too hard a blow on the breaking knife and then did not turn the crack upward, consequently a large amount of white leaked from the egg into the drip tray.

Because of the large number of eggs with incipient odors and because of the large percentage of bad eggs in the breaking stock, the girls were continuously in need of assistance in deciding on doubtful eggs. On account of the unreliability of the girls and the importance of careful grading, it was absolutely necessary that a well-qualified person should have charge of the breaking room.

During this period 31 samples of the commercial product were obtained—five from the large storage tanks in the breaking room and the balance in the drying room before and after desiccation.

The five samples taken from these tanks had about double the number of bacteria found in similar specimens taken on visit No. 2. The number of bacteria in the present samples is shown in Table E–IV (Appendix, p. 72). There was also a slight increase in the amount of ammoniacal nitrogen.

The laboratory results showed no marked changes in the dried product when compared with those obtained during the previous experimental period.

Visit No. 4 (June 24 to 28).

The egg supply consisted of one half checks and the other half a mixture of seconds and dirty eggs.

The management had not succeeded in obtaining a forewoman to replace the one who left during visit No. 3. An attempt was made to promote a conscientious girl from the ranks, but the breakers absolutely refused to recognize one of their number as their head. The position required a good disciplinarian as well as one who could appreciate and enforce the principles of bacterial cleanliness as applied to the preparation of food on a large scale.

The supply of eggs was not sufficient to keep the girls at work the whole day. They received the same daily wage whether they worked all or part of a day, consequently there was a concerted effort to break the eggs in as short a time as possible. This undue haste led to unclean work and to careless grading.

The low quality of the work during this week, as well as the untidy appearance of the breaking room, showed what can be expected when a number of irresponsible girls are allowed to work without direct and strict supervision.

The work of the candlers was superior to that of the breakers. The foreman, shortly before this visit, was directed to recandle daily the rejects from the different candlers. The finding of only six edible eggs on breaking one-half case of rejects after secondary candling indicated that the work was being done very efficiently.

From a chemical and bacteriological viewpoint the quality of the liquid and dried product was practically the same as found on the last visit. A few samples of desiccated egg, however, contained more organisms than had been noted heretofore. The wet lumps showed no greater infection than the flaky egg.

Visit No. 5 (July 19 to 24).

The conditions in the breaking room were greatly improved because the superintendent had been able to give some attention to the breakers. The egg supply had not increased, consequently he was able to reduce the breaking force to a number sufficient to complete the work by the regular closing time. He dismissed the more inefficient girls and particularly those who had been promoters of disorderly work. This culling resulted in an altogether different spirit in the breaking force, for each of the remaining girls was not only anxious to do good work but was also desirous of retaining her position.

With this change in the attitude of the breakers it was a comparatively simple matter to get them to manipulate the egg properly, to break at a sufficiently low speed to permit careful grading, and to make the necessary changes in apparatus after opening an infected egg.

As a consummation to the improved conditions, the superintendent succeeded on July 16, 1913, in getting a forewoman whom the girls immediately and cheerfully recognized as their superior. The young woman was trained along sanitary lines, consequently she could appreciate the principles of bacterial cleanliness which were being applied here to the preparation of frozen and dried eggs. By instruction and observation she quickly learned to recognize the various kinds of eggs occurring in breaking stock, and was soon competent to supervise grading as well as clean handling of eggs. Gum chewing was prohibited among the girls, since with such a highly flavored substance in the mouth, eggs with incipient odors would not be detected.

She also stopped conversation between breakers because it was necessary for best results that a girl give her entire attention to her task. As a compensation for steady work the forewoman gave the girls a five-minute recess in the middle of each half day. The increased efficiency of the breaking force under the new régime more than balanced the time utilized by the intermission.

On one of the first days of the visit two of the breaking girls were given the position of pages. Their duties were to transport the trays of clean apparatus from the wash room to the breaking room, to carry the same back when dirty, and to look after the general appearance of the breaking room. Formerly the breakers stopped their work to do these errands. Inasmuch as this work kept the pages busy, this change in the organization did not add to the operating expenses, but greatly facilitated the work of the breakers.

A few changes in equipment had been made since the last visit. For instance, new racks had been made to hold the breaking knives from the time they were washed until they were used in the breaking room. Another change was the placing of a clockface with movable hands on each sterilizer door. After filling a sterilizer with apparatus, the operator noted the time of day and placed the hands of the clockface at the

hour and minute when the supply of steam should be cut off. This mechanism enabled the operator to know definitely that each portion of apparatus was sterilized for 25 minutes.

The egg supply consisted of current receipts as well as checks, dirties, and seconds.

The general candling of the receipts was fair, but the recandling of the discards was not accurate. The latter duty had been assigned to one of the regular candlers because the foreman was now checking the work of individuals candling to select good eggs to go to the breaking room. He recandled pails of eggs selected at random, and when he found an undue number of deteriorated eggs he notified the original candler. Under this system of overinspection the girls developed more care in grading.

Quantitative determinations given in Table E–IV (Appendix), under visit No. 5, showed that samples of the regular breaking stock contained 46.9 per cent more bacteria and 10 per cent more ammoniacal nitrogen than did similar samples obtained on the previous visit. Similarly, Table E–III shows that the desiccated product contained more organisms than did the samples taken on the preceding visit. The larger amount of bacteria in the liquid egg probably accounts for this increase. The increase in the bacterial content was no doubt due to the hot weather which prevailed during the first half of July.

The data on the commercial product, as recorded in Table E–IV (Appendix), prepared from current receipts, showed the same amount of loosely bound nitrogen as did the eggs discussed before, but the number of bacteria was about one-third less. The latter difference may, perhaps, be explained by fewer infected eggs in current receipts as compared with the seconds, dirty, and cracked eggs of the regular breaking stock.

Visit No. 6 (August 5 to 9).

The egg supply consisted of the same classes of eggs as on the previous visit, but there were fewer current receipts.

The general candling was good, and the recandling of the discards was improved. The breakers were doing good work under the direction of the new forewoman. In fact, the management of the breaking room was better than it had been at any time during the season.

As the firm was putting up an order of dried yolk, about one-third of the breaking force was separating eggs into white and yolk. The separation was effected by a trough separator of the gravity type. This device was effective for spring eggs, but was not very efficient for the soft eggs which occurred at this period. The girls, consequently, were continuously removing broken yolk from the apparatus, and with the best of manipulation they could not prevent portions of yolk getting into the white.

Bacteriological and chemical examinations of whole egg before and after drying proved the breaking stock to be of practically the same quality as on the preceding visit. The weather was cooler during the latter half than it was during the first part of July, consequently there was no greater deterioration in the egg supply.

Table E–VI (Appendix p. 76) gives the results of 13 samples of white and yolk separated by the device already described. The maximum number of bacteria found was 1,800,000; the minimum 1,000. It is of interest in this connection to note that the counts in every case are lower than those in synchronous samples of whole egg taken from the large storage tanks. It is probable that the soft eggs which enter the latter product offer an explanation of its higher bacterial content.

Samples were taken of the product broken each day during the interval between visits No. 5 and No. 6. During this interval the management purchased 1,153 cases of firsts which had been deluged with water while a fire was being extinguished in the building in which they were stored. A chemical examination of the eggs proved them to be comparatively fresh and to contain no more water than is ordinarily found in breaking stock. The eggs were broken in three days' time, but the last portion was not finished until four days after receipt because a Sunday intervened between the last two days. The forewoman stated that the grading was simple on the first and second days, but was very perplexing on the last day, because many of the eggs had become musty. The mustiness of these eggs pervaded the atmosphere of the breaking room to such an extent that it was almost impossible to detect any other odor. The changes observed in these eggs indicate that the wetting of shells plays a part in the production of musty eggs.

It is interesting to observe the increase in the number of bacteria in the product broken each day. The count on the first day was 1,600,000; on the second, 2,400,000; and on the fourth, 5,100,000 per gram. The *B. coli* numbered 10,000 in the liquid egg broken on Friday and Saturday and 100,000 in the product obtained on Monday. The amount of ammoniacal nitrogen found in the eggs was practically the same on

the fourth day as on the second. The bacteria, therefore, had not multiplied sufficiently to break down the protein material of the egg.

The management held the regular receipts, including the checks, until all the wet eggs were broken. Two samples taken of the liquid product made from cracked eggs kept in a chill room four days had a count of 4,500,000 in one case and 5,400,000 in the other, as compared with 1,100,000 and 1,600,000 in eggs broken immediately on receipt. These results show the deleterious effect of holding warm-weather checks, even if they are kept in cool surroundings.

Visit No. 7 (August 19 to 24).

The seventh and last trip to this house was made during the last week the plant was in operation.

The breaking stock consisted of the same classes of eggs as are discussed under the sixth visit, with the exception of some dirty eggs which had been in storage since the middle of April. The low quality of the receipts was shown by the fact that over 20 per cent was rejected by candling. Since it was impossible to purchase a sufficient supply of eggs to fill the orders for the desiccated product, the firm was melting frozen stock prepared earlier in the season and mixing it with the liquid egg direct from the breakers.

With the decrease in receipts the candling, breaking, and drying forces were reduced. It now required only eight girls to break the egg supply.

During the interval between this and the previous trip daily samples were taken from the large storage tanks. These samples were obtained before the management began mixing frozen and liquid egg, hence they are comparable with previous samples from the large tanks. Table E–IV (Appendix), visit No. 7, shows that the average count of samples taken on the sixth visit was 4,300,000 per gram; of the specimens obtained on the present trip, 5,700,000. A similar increase in the amount of loosely bound nitrogen was also observed. These results also show the low quality of the receipts.

Five samples of the liquid mixture, composed of frozen and shell eggs, gave, as expressed in Table E–V (Appendix), under visit No. 7, counts varying from 6,400,000 to 19,000,000 per gram. The amount of ammoniacal nitrogen determined was greater than was ordinarily found in food egg. From a bacteriological and chemical viewpoint these samples showed more deterioration than any previous series of specimens taken from the food product prepared by this house. The deleterious effect of rehandling the frozen eggs, together with the low quality of the shell-egg stock, is the probable explanation of this low-quality product. Since the laboratory results of these samples are not comparable with those of the general output, they will not be included in the general averages.

CONDITIONS OBSERVED IN F HOUSE DURING TWO CONSECUTIVE YEARS.

Season of 1911.

CONSTRUCTION, EQUIPMENT, AND ROUTINE.

The building in which this egg-breaking plant is established is built of brick and is several stories in height. The room in which the eggs are broken was located in a corner of the second floor and faced two streets. It had three windows on one side and one on the other. In cool weather—which was but seldom—these windows were kept closed. They were screened against flies. A supply of air, which was washed but not chilled, was fanned into this room, but it was not considered adequate for ventilation. At one end of the room a raised concrete platform held a sink with hot and cold water and a small steam table; along one side of the room was another concrete platform holding churns for the mixing of the egg. The remainder of the room, which was occupied by the egg breakers, was floored with hard maple. The walls and ceiling were plaster, white enameled. Two doors, one at each end of a side wall, served for entrance and exit. The temperature of the room seldom rose above 80° F.

The 40 girls employed worked at five zinc-covered tables. One girl at each table presided over the other seven and was responsible to the foreman. White caps and half-sleeve gowns were worn, completely covering all garments.

Early in the season the eggs were emptied from the shells into white-enameled cups, three of which were set in a white-enameled pie plate. The shells were cut on a small piece of steel clamped across one cup. This apparatus is pictured in figure 7. Yolks, whites, whole firsts, whole seconds, and tanners' grades were made. The drippings from the eggs collected in the plates and were objectionable. A suggestion to the manager resulted in the placing of metal racks in the pie plates, thus lifting the bottom of the cups out of the drip.

The liquid egg was collected in agateware buckets holding 20 pounds. From these it was transferred to the churns and then drawn by a gate valve into the 30-pound cans, which served as the final containers.

It was the custom of the girls in this house to use rags of various sorts for wiping fingers, cups, tables, and the floor indiscriminately. The utensils were washed in hot water, but frequently the girls, in an excess of zeal, would wipe a comparatively clean piece of apparatus on a wet bacteria-laden rag, thereby very largely undoing the good done by washing. Fingers were constantly wet.

The supply of incoming eggs in the shell was chilled before candling. Frequently there was an interval of several days between the candling and the breaking of the eggs. Even though the eggs were kept under refrigeration, it was found better to break immediately after candling (see p. 40).

The work of the candlers was fair; but too many eggs that should have been stopped in the candling room found their way to the breakers. This resulted, as it always does, in lax grading and carelessness in changing apparatus after breaking a bad egg.

The general principles of bacterial cleanliness to be striven for in the egg breaking were discussed with the management, and it was decided to try several breaking outfits and systems of operation, using the table of eight girls as a unit. From these experiments there evolved a new breaking outfit. This consisted of metal racks supported on a traylike base and having an adjustable knife, which could readily be removed after a bad egg had been cracked on it. Glass sherbet cups received the eggs. A mechanical separator of white and yolk, which could be attached to the knife, was also devised. Until this invention the shell method of separating had been used.

The table was also modified in that four holes, each about 5 inches in diameter, were cut in a row down the middle. Below these were set the shell cans and into them were fitted galvanized-iron funnels, that the shells might be more accurately and easily guided into the cans below.

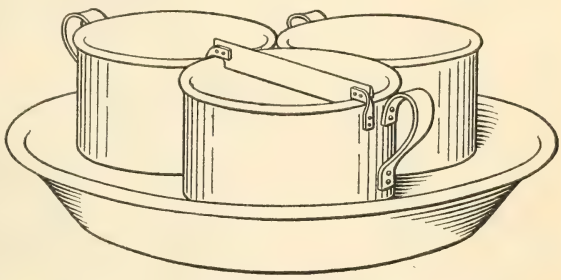

FIG. 7.—Outfit used for egg breaking before remodeling.

Tissue paper was provided for drying fingers, and the rags were abolished. A little steam sterilizer was also rigged up for experimental purposes only.

When the girls had become somewhat accustomed to the new forms of apparatus, some laboratory examinations were made of the output prepared under the old and the new conditions. The comparative results are given in Table 20.

EXPERIMENTAL AND COMMERCIAL SAMPLES.

A mixture of summer firsts and seconds when broken under the cleanly conditions just described and when the apparatus and containers were steam sterilized gave the results for white and yolk shown in Table 20, Part I, experiments Nos. 519 and 518. The total number of bacteria is low and *B. coli* were not found in a 1 to 100 dilution. A repetition of this test, using seconds only and the old type of breaking outfit, gave equally as good results, as is shown in experiments Nos. 526 to 528, inclusive.

Cracked eggs, which had been candled the day before, were also broken on the new tray and with sterilized apparatus. The findings on these eggs are recorded in experiments Nos. 520 to 525, inclusive. It will be observed that grading became necessary in this experiment. From the two cases broken, the routine grading practice of this house yielded 1½ pounds of a second-grade liquid egg, and between 2 and 3 pounds of tanners' egg. The latter included the drip which collected in the breaking trays. The number of bacteria in white and yolk from these checked eggs were not very numerous, though higher than in the sound eggs of similar grade. The whole egg contained some that had soft yolks, and the second-grade whole egg consisted almost exclusively of eggs of this variety, with some that were beginning to sour. The very high bacterial content of the second-grade whole egg again indicates that a study of grading was needed to supplement that of cleanliness. The bacteria in the tanners' egg were reduced in number by the amount of drip which entered it. The drip from clean trays and cups is very different, bacterially, from that collecting on rough and unsterilized apparatus.

TABLE 20.—*Experimental and commercial samples of whites, yolks, and whole egg (F house, 1911).*

EFFECT OF STERILIZATION OF UTENSILS UPON FINAL PRODUCT.

Sample No.	Description of sample.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.	Ammoniacal nitrogen (Folin method).		Moisture.
			20° C.	37° C.			Wet basis.	Dry basis.	
	I.								
	Eggs broken in apparatus steamed 15 minutes:								
	Firsts and seconds—						*Per cent.*	*Per cent.*	*Per cent.*
519	Whites, 60 dozen	Aug. 12	120,000	(1)	(1)				
518	Yolks of No. 519	...do	41,000	(1)	(1)				
	Seconds—								
526	Whites	...do	69,000	(1)	(1)				
527	Yolks of No. 526	...do	(1)	(1)	(1)				
528	Whole egg	...do	37,000	(1)	(1)				
	Cracked eggs—								
520	Whites	...do	660,000	250,000	1,000		0.0004		
521	Yolks of No. 520	...do	450,000	390,000	10,000		.0037		
523	Whole egg	...do	1,000,000	520,000	10,000		.0026		
524	Second-grade whole egg, 1½ pounds	...do	[2]100,000	370,000,000	100,000		.0047		
525	Tanner's egg, 2 to 3 pounds	...do	58,000,000	70,000,000	1,000,000				
	Seconds, clean shelled—								
538	Whites	Aug. 14	(1)	(1)	100	Present.			
539	Yolks of No. 538	...do	(1)	(1)	100		.0040		
540	Whole egg	...do	1,400,000	1,300,000	(1)		.0022		
543	Do	Aug. 15	(1)	(1)	(1)		.0021		
544	Tanner's egg	...do	81,000,000	64,000,000	100	1,500,000			
	Dirty eggs—								
545	Whole egg	...do	450,000	390,000	10,000	Present.	.0022		
546	Tanner's egg	...do	320,000,000	480,000,000	100,000	Present.			
	II.								
	Eggs broken in apparatus cleaned according to commercial routine:								
	Cracked eggs (same lot of eggs as Nos. 520 to 525, inclusive)—								
534	Whites	Aug. 14	61,000,000	67,000,000	1,000,000	Present.	.0006		
535	Yolks	...do	4,000,000	2,800,000	1,000,000	Present.	.0038		
536	Whole egg	...do	1,100,000	580,000	100,000	Present.	.0022		
	Dirty eggs—								
547	Whole egg	Aug. 15	8,700,000	8,400,000	1,000,000		.0022		

	III.								
	Desiccated egg during the process of preparation:								
	Cracked eggs—								
530	Liquid whole egg from churn	Aug. 14	2,600,000	2,300,000	10,000	Present.	.0022		
531	Liquid whole egg from supply tank to belt	...do....	4,400,000	4,000,000	100,000	Present.	.0020		
532	Desiccated egg	...do....	27,000,000	22,000,000	1,000,000	Present.	.0015		
	Clean seconds—								
541	Liquid whole egg from pails	Aug. 15	1,400,000	1,300,000	100,000	250,000	.0025	0.0063	60.55
542	Liquid whole egg from churn	...do....	2,400,000	1,300,000	10,000		.0020		
551	Liquid whole egg from supply tank to belt	...do....	19,000,000	18,000,000	1,000,000	2,500,000			
550	Desiccated egg	...do....	33,000,000	26,000,000	100,000		.0011	.0012	11.96

[1] Less than 1,000.

[2] Innumerable in a dilution of 1 to 100,000.

Clean seconds, after clean breaking and collecting, gave the products listed under Nos. 538 to 540, inclusive, and again in experiment No. 543. Again the yolks and whites showed less than 1,000 bacteria per gram. From lot 543 was obtained the sample of tanners' egg, given in experiment No. 544. A count of 81,000,000 bacteria is accounted for by the fact that the egg was composed chiefly of green-white eggs, sour eggs, and the drip from the trays.

The foregoing findings are encouraging in that they correlate bacterial findings with cleanliness and grading. To confirm this indication, similar eggs were broken with the old apparatus cleaned by water alone and using the old methods of procedure. Under such conditions, checked eggs from the same lot as those used in experiments Nos. 520 to 525 were broken and prepared as white and yolk as well as whole egg. The number of bacteria in these samples varied from 67,000,000 to 1,100,000, a sharp contrast to the experimental product just discussed. The ammoniacal nitrogen is practically identical with that obtained previously. These eggs were traced through the operation of churning and drying, with the results shown in samples Nos. 530 to 532, inclusive, the counts running between 2,600,000 and 4,400,000 on the liquid egg and reaching 27,000,000 for the dried product. The count on sample No. 532, however, the dried product, must be divided by 3 to make it comparable with the liquid egg. It will be observed that every step in the process caused an increase in the number of organisms. Checked eggs commonly run higher in bacteria than do eggs with sound shells of comparable grade. It was, therefore, decided to break some sound, clean eggs by the old methods for comparative purposes. The findings are given as samples Nos. 541 to 550, inclusive, and show a maximum bacterial content of 33,000,000. This series traces the whole egg from the first collecting pails to the dried product. The initial count of the liquid egg, namely, 1,400,000, is comparable with that given for No. 530.

Dirty eggs were also to be studied as checks and seconds had been. To this end samples Nos. 545, 546, and 547 were prepared. The clean routine gave a count of 450,000 per gram, with 10,000 *B. coli*, whereas the old methods of breaking dirty eggs gave 8,700,000 total count and 1,000,000 *B. coli*. These eggs had unusually filthy shells and were a severe test of cleanliness of handling.

Such preliminary experiments serve to confirm and extend the findings for houses B, C, and E, as seen during 1911.

Season of 1912.

CHANGES IN CONSTRUCTION AND EQUIPMENT.

The breaking room of F house was not reconstructed in strict accordance with the experimental requirements of this investigation because the management was planning to remodel the entire establishment in the near future. Some important changes, however, were made in the breaking equipment, and a separate wash room was built so that all utensils could be washed outside the breaking room. Plate VII and Plate VIII, figure 1, picture the latter with the equipment in 1912.

The egg supply was conveyed to the breaking room in the usual shipping cases. Fillers were omitted, if the eggs were not cracked. These containers, and particularly the ones used for checks, carried more dirt into the room than was taken in by any other means. The galvanized-iron buckets shown in two of the pictures were used experimentally for cracked eggs.

The breaking outfit used during the latter part of 1911 had been improved. (Pl. VIII, fig. 1; Pl. X, fig. 1.) The tray was made of iron, heavily plated with tin. The eggs were broken on a piece of spun brass inserted in one portion of a tool-steel breaking knife. The whole was tinned. It was notched at each end to fit over set screws in the two uprights. The breaking cups were made of spun brass plated with aluminum. They were supported and held in place by small pieces of spun brass soldered to the bottom of the pan. These, also, were tinned.

The pictures show the position of the cups in the tray. The one under the breaking portion of the knife caught the drip from the eggs while they were bring cracked; the second underneath the separator was used for whites and the one next for yolks. The fourth, located at one side of the drip cup, was used for soft eggs. If the eggs were not separated the fourth cup was not used. On the lower side of the tray at each corner were soldered pieces of metal which served to anchor the outfit to the breaking stand. The latter was made of spun brass plated with tin.

From a viewpoint of convenience of manipulation and ease of cleaning, the breaking outfit was very efficient. One defect, however, was the substitution of metal for glass cups. The former, on account of being opaque, interfered with grading in-

cipient forms of deteriorated eggs such as "beginning greens." This difficulty was minimized, however, when the eggs were separated into white and yolk, because a very fair view of each egg was obtained during the process of mechanical separation. Inasmuch as by far the greater part of the commercial product of this house was prepared from separated stock, this imperfection in the breaking apparatus was not as much of a detriment to the product as a whole as would be the case if used when whole egg constituted the principal output.

After the eggs were broken they were poured from the cups into new 30-pound cans, which, after one-half day's service, were cleaned and used for final containers of frozen egg. The tables supporting the breaking outfit and the containers of the shell eggs and liquid egg were the same, with a few modifications, as used during the season of 1911. A fair idea of the construction of the tables and the arrangement of the apparatus on them can be ascertained from the pictures. The stools were of sanitary construction. Particular attention had been given to the height of breaking stands, tables, and stools, in order to make them comfortable and convenient for the breakers.

Three new sanitary washbowls installed in the center of the room (Pl. VII) were used mostly for rinsing yolk from separators; a fourth (Pl. XI, fig. 2), located under the wash-room window, was used for washing hands.

Linen towels about six inches square were used both for wiping hands after washing and for drying fingers during egg breaking. A towel was used only once, then laundered. A supply was kept on racks suspended above each table and on a shelf over the washbowl under the window.

For the assistance of persons contemplating the purchase of egg-breaking equipment the following inventory is given of the number of pieces of small apparatus used by the 52 girls of this breaking room during the season of 1912:

Breaking knives	134	Egg separators	97
Cups	379	Aluminum spoons	57
Trays	61	Finger towels	4,320

From these data the number of utensils necessary for a room with a smaller or larger working capacity can be calculated.

The wash room was 12 feet square; the walls were plastered and covered with enamel, and the floor was made of cement. The latter sloped toward a drain located at one side of the room. The washing equipment was unique; it consisted of a round-bottomed sink, two revolving brushes, two rinsing devices, a steam jet, a dairy sterilizer, a chute for transferring clean cans to the breaking room, and a sliding window for passing apparatus back and forth between the wash room and breaking room. (Pl. XI, fig. 2; Pl. XII, figs. 1, 2.) The equipment was so arranged that it saved time and labor.

The sink was supplied with an abundance of hot and cold water and was furnished with a perforated draining rack. A pan beneath the latter conveyed the drippings back to the sink.

The two mechanical brushes were driven at a speed of about 300 revolutions per minute by a one-quarter horsepower motor supplied with reducing belts. One of the brushes originally designed for cleaning milk bottles was used to wash breaking cups; the other was specially constructed by bolting ordinary scrubbing brushes to an aluminum center and was used for scrubbing 30-pound cans that were smeared with egg.

The device pictured in the extreme right end of the sink consisted of a nozzle and a percussion valve connected with a water pipe. When the nozzle was pressed down the valve opened and water sprayed out. This mechanism was used for rinsing cups.

The conical-shaped fixture at the left of the can brush was supplied with both a water and a steam jet and was used for rinsing and steaming large utensils.

Routine of Handling Product.

As soon as the preliminary container was full the eggs were transferred promptly to cool surroundings. The whites were weighed into either 10 or 30 pound cans and immediately conveyed to a freezer. The yolks and whole egg were poured into the mixing churns and cooled to a temperature just above freezing. If the liquid was to be frozen it was weighed into 30-pound cans and taken to a freezer; if the egg was to be desiccated it was drawn off into 40-quart milk cans and taken to the drying room. The product, however, was kept in a chill room if any time intervened between cooling and desiccation. The desiccation of the liquid egg has already been discussed in detail on page 15.

CONDITIONS PREVAILING EVERY THIRD WEEK FROM MAY UNTIL SEPTEMBER.

Visit No. 1 (first week in May).

Organization of wash room.—The new washing equipment having just been installed, experiments were made to determine the quickest and most effective methods of cleansing the various utensils used in the breaking room. As a result of these experiments and observations working directions were prepared, which may be summarized as follows:

1. Rinse new cans in running water and steam in the dairy sterilizer for at least 10 minutes. If the cans show visible signs of uncleanness, such as dust, scrub before rinsing.

2. Wash all utensils coming in contact with food egg in clean, lukewarm water containing soap powder. Use the revolving brushes for cleaning the breaking cups and 30-pound cans. Rinse the cups on the mechanical rinser. Wash the other apparatus with ordinary scrubbing brushes and rinse in running water from the faucet. Sterilize all the apparatus for at least 20 minutes.

3. Keep the brushes sweet by frequent sterilization.

4. Exercise particular care in scrubbing and rinsing the mixing churns. Run steam through a steam hose into each churn for five minutes.

5. At noon wash spoons, knives, cups, and breaking trays; rinse and sterilize all but the last. Wipe off tables. Put new sterilized cans on them in place of those used to receive the broken eggs during the morning.

6. At night cleanse all apparatus, sterilize the pieces coming in contact with food egg, and perform the other necessary cleaning, such as scrubbing floors, washing walls, etc.

Bacteriological examinations showed that the churns, after being carefully washed with warm water containing soda, rinsed thoroughly, and steamed for five minutes, were practically sterile. The churns were so constructed that the brine could not be drawn from the cooling coils. On account of the expansion of the cold liquid it was impossible to steam the churn longer than five minutes at one time. Because of the importance of the cleansing previous to steaming this work was delegated to a picked crew of girls.

Experiments similar to those carried on in the new wash room were undertaken in the workroom in which utensils from the egg-drying room were cleansed. The washing equipment for this work was located on a drained cement floor and consisted of a steam jet and a sink supplied with hot and cold water. All apparatus was being thoroughly washed, but not rinsed; the larger pieces were being heated for a few seconds over the steam jet. The pieces of hose used to convey the liquid egg from the supply tanks to the troughs feeding the belts were scrubbed on the inside with a specially devised brush, rinsed and steamed.

Laboratory tests of condensation water from apparatus washed and steamed as described showed about 200 bacteria per cubic centimeter. An examination of sterile water passed a few times through a cleansed hose also disclosed several hundred organisms to the cubic centimeter.

Inasmuch as the heating of apparatus over a steam jet was inconvenient, time consuming, and did not insure sterilization, a box sterilizer was planned, so that the small utensils from the drying room and the milk cans used to transfer the liquid egg from the breaking room could be sterilized for 20 minutes. The supply tanks to the belts were too large to put in the sterilizer. Consequently, they were sterilized by passing steam into them from a hose. A rinsing jet was also installed in the sink. These additions to the washing equipment greatly simplified the work of this department.

The efficient operation of the two wash rooms insured thorough cleansing of all utensils coming in contact with liquid food egg.

Breaking stock.—The breaking stock of this house consisted of small, dirty, and cracked eggs sorted by inspection from the current receipts of this house, its several branch houses, and a few neighboring packers who did not have facilities for egg breaking. The firm did not pay for leakers and moldy eggs occurring in "checks" from the latter source.

The breaking stock of this period consisted chiefly of cracked eggs, because a large percentage of the small and dirty eggs were being shipped in the shell. The firm began candling checks on April 12, 1912, and current receipts on May 6, 1912.

Organization of breaking room.—The foreman of the breaking room was eminently qualified for his position on account of his training and executive ability. He had been in charge of this breaking room from the time of its establishment, and previous to that time he had supervised a candling room. Consequently, he was familiar with the various classes of eggs occurring throughout the season.

At this time there were about six tables in use, each having a capacity of eight girls. Inasmuch as the successful operation of this room required constant detailed supervision, one girl at each table was made responsible for the work of the other seven, as in 1911. The foreman gave his orders to the table chief rather than to each individual girl. With such an organization it was possible for the management to inaugurate changes and to make rules for routine and be assured that they would be enforced.

The product.—The management was preparing frozen whites, frozen tanners' egg, dried yolks, and a dried mixture compounded from one part yolk and two parts whole egg. The latter product was termed in this investigation "mixed egg."

Two series of experiments showed, as illustrated in Table F–I (Appendix, p. 80), that the liquid egg was not contaminated as it passed from the cans on the breaking tables through various containers to the drying room.

The mixed egg sampled for these observations was broken from cracked eggs. The bacterial content varied from 800,000 to 1,300,000 per gram in the different samples. The lowest number of *B. coli* observed was 1,000 and the highest 100,000 per gram.

The percentage of ammoniacal nitrogen found in two samples of mixed egg was 0.0017 on the wet basis. In five samples of whole egg used in the preparation of this product, the amount of this constituent varied from 0.0014 to 0.0017 per cent. These nitrogen determinations prove, therefore, that the classes of spring eggs used in the preparation of mixed egg were, commercially speaking, fresh.

Two samples of desiccated product prepared from the two lots of mixed egg, taken in connection with the study of outside contamination, contained 650,000 bacteria per gram in one case and 1,000,000 in the other. These counts, when divided by 3 to make them comparable with liquid egg, indicate that bacteria were killed during desiccation. The moisture content averaged 11.85 per cent in these two samples taken directly from the belts and 4.32 per cent after secondary drying. The bacteria in the two products were not materially affected by the latter process.

Two samples of desiccated yolk, as given in Table F–II, visit 1 (Appendix, p. 81), showed the widely divergent counts of 71,000 and 17,000,000 per gram. The latter count was probably caused by multiplication of bacteria during desiccation because the highest number discovered in 19 samples of liquid-food egg was not over 1,300,000 per gram. Later samples also justify this supposition.

Samples of white, yolk and tanners' egg obtained from cracked eggs by four girls using the same receiving cans gave the results shown in Table 21, visit 1, which indicate that the eggs were of good quality; that they were graded carefully and that the technic of breaking was clean. Since the white and yolk were obtained from only two cases of eggs, the counts can not be taken as an indication of the bacterial content of the general output. This statement is verified by the differences in the number of bacteria in various lots of breaking-stock eggs opened under the same conditions as the samples just discussed. For example, counts of 600, 500,000, and 600,000 were obtained from three different cases of checks, and 300 and 600,000 from two lots of seconds.

Visit No. 2 (May 20 to 24).

The breaking stock consisted of one-half small and dirty eggs and the other half checks. All receipts were now being candled, consequently the breaking stock was practically free from deteriorated eggs with the exception of those which could be detected only when out of the shell.

After the new box sterilizer was installed for steaming utensils from the drying room, there was practically no contamination of the product from improperly cleansed utensils. The bacteria in the liquid-food eggs were, therefore, due to the organisms occurring originally in the shell eggs and to contamination during breaking. The problem henceforth was to determine to what extent the bacteria from these two sources could be eliminated.

Since the previous visit the management had changed the system of grading. Eggs showing no signs of deterioration were used in a first-grade product in the form of either whole eggs, whites, or yolks. Soft eggs, not separable into white and yolk, were used in the whole eggs and graded as firsts. A typical soft egg is also pictured in Plate XIV. The commercial mixture was made from yolks and whole eggs. A second-grade food article was prepared from drip and incipient forms of sour, moldy, green-white eggs and all eggs of a doubtful quality. The third grade, or tanners' egg, was made of the rejects from the candling and breaking room, minus eggs with a strongly objectionable odor, such as musty eggs. Since good eggs have to be discarded when a bad egg is broken in a cup with them, a large number of good eggs were also present in the tanners' stock.

TABLE 21.—*Comparative data showing the efficiency of the grading of breaking stock (F house, 1912).*

Sample No.	Description and size of sample.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.	Ammoniacal nitrogen (Folin method).		Moisture.
			20° C.	37° C.			Wet basis.	Dry basis.	
	Visit No. 1.						*Per cent.*	*Per cent.*	*Per cent.*
	Cracked eggs:								
4218	Whites, 30 pounds	May 2	36,500	1,400	100	0 in 100	0.0002	0.0016	87.36
4219	Yolks, 30 pounds	do	6,800	700	100	0 in 100			
4220	Tanners' egg	do	46,000,000	12,000,000	1,000,000	11,000,000			
	Visit No. 2.								
	Seconds:								
4366	Whites, 30 pounds	May 21	4,200,000	1,100,000	1,000	1,500,000			
4367	Yolks, 30 pounds	do	1,600,000	230,000	100	310,000			
4368	Soft eggs, 10 pounds	do	35,000,000	10,000,000	100	2,500,000	.0024	.0084	71.54
4369	Second-grade eggs, 3 pounds	do	27,000,000	1,900,000	10,000	18,000,000	.0040	.0182	78.07
	Visit No. 3.								
	Regular breaking stock:								
4495	Whites, 10 pounds	June 10	1,000	500	100	0 in 1,000	.0004	.0031	87.04
4496	Yolks, 10 pounds	do	7,000	4,500	10	5,000	.0040	.0093	56.96
4497	Soft eggs, 3 pounds	do	390,000	320,000	100,000	14,000	.0020	.0071	71.91
4498	Second-grade eggs, 10 pounds	do	4,200,000	2,400,000	100,000	50,000	.0014	.0068	79.35
	Seconds:								
4499	Whites, 30 pounds	June 11	110,000	150,000	100	100,000			
4500	Yolks, 30 pounds	do	110,000	140,000	100,000	70,000			
4501	Second-grade eggs, 25 pounds	do	22,000,000	12,000,000	1,000,000	6,500,000	.0022	.0079	72.27
4509	Whites, 30 pounds	do	460,000	180,000	10	0 in 10,000	.0006	.0046	87.01
4510	Yolks, 30 pounds	do	1,500,000	750,000	100	0 in 10,000	.0045	.0103	56.35
4511	Soft eggs, 30 pounds	do	14,000,000	4,300,000	10,000		.0029	.0098	70.49
4512	Second-grade eggs, 10 pounds	do	59,000,000	38,000,000	1,000,000	5,500,000	.0026	.0130	80.02
	Visit No. 4.								
	Regular breaking stock:								
4656	Whites, 25 pounds	July 2	29,000	1,500	10	20,000			
4657	Yolks, 25 pounds	do	5,300,000	1,000,000	10,000	10,000			
4658	Soft eggs	do	130,000	13,000	1,000	190,000	.0021	.0075	71.95
4659	Second-grade eggs, 10 pounds	do	6,800,000	10,000,000	100,000	5,000,000	.0008	.0052	84.60

	Visit No. 5.								
	Regular breaking stock:								
4793	Whites, 18 pounds	July 22	7,500,000	5,400,000	0				
4794	Yolks, 10 pounds	do	7,200,000	5,200,000	10		.0035	.0080	56.33
4795	Soft eggs, 22 pounds	do	3,600,000	3,000,000	1,000		.0025	.0083	70.02
4796	Second-grade eggs, 3 pounds	do	7,300,000	5,500,000	10,000		.0026	.0097	73.20
4806	Whites, 10 pounds	do	200,000	220,000	10				
4807	Yolks, 12 pounds	do	41,000	31,500	10		.0037	.0080	53.74
4808	Soft eggs, 25 pounds	do	(1)	63,000,000	10,000		.0031	.0094	67.04
4809	Second-grade eggs, 10 pounds	do	92,000,000	72,000,000	10,000		.0021	.0111	81.02
	Visit No. 6.								
	Firsts:								
4952	Whites, 28 pounds	Aug. 12	850,000	550,000	1,000				
4953	Yolks, 25 pounds	do	850,000	700,000	1,000		.0034	.0075	54.60
4955	Soft eggs, 5 pounds	do	1,700,000	1,400,000	100,000		.0020	.0072	72.39
4954	Second-grade eggs, 15 pounds	do	84,000,000	79,000,000	100,000		.0022	.0078	71.79
	Seconds:								
4977	Whites, 20 pounds	Aug. 14	40,000	40,000	100				
4978	Yolks, 20 pounds	do	130,000	130,000	0		.0037	.0087	57.25

[1] Innumerable in 100,000.

Three consecutive samples of "mixed egg" taken from the hose, from the drying belts, and after secondary desiccation, contained 6,800,000, 10,000,000, and 21,000,000 bacteria per gram, respectively. The ammoniacal nitrogen in the liquid egg was also high for spring eggs. These results were the exception, for a second sample, liquid "mixed egg," had a low percentage of ammoniacal nitrogen and showed 470,000 bacteria per gram. Additional specimens of the desiccated product contained not more than 800,000 in four cases and 3,100,000 in a fifth. The results cited are charted in Tables F–I, F–III, and F–IV under visit No. 2. (Appendix, pp. 80, 82, and 83.)

Four samples taken from cans on the breaking tables gave interesting results, as shown in Table 21. The whites and yolks had a higher bacterial content than is ordinarily found in spring eggs. The counts of the soft and second-grade eggs were 35,000,000 and 27,000,000, respectively, whereas the amount of ammoniacal nitrogen, as calculated on the dry basis, was 0.0084 and 0.0182 per cent, respectively. It will be noticed that, although there were more bacteria in the soft eggs, they did not show as much chemical change as the second-grade product. This can, perhaps, be explained on the ground that even sterile eggs show an appreciable increase in loosely bound nitrogen after long keeping, due, in all probability, to enzyme action.

Three other samples of the second-grade eggs proved to be heavily infected (27, 47, and 58 million bacteria per gram), as illustrated in Table F–V (Appendix, p. 84) under visit No. 2. Since the water content of this grade of eggs varies with the amount of drip, or albumen contained in it, the chemical results must be calculated on the dry basis before conclusions can be drawn. The percentage of ammoniacal nitrogen in these three samples, thus figured, was practically identical with that found in tanners' egg (0.0111 to 0.0182 per cent). Additional samples of this grade of egg were taken on the next visit.

Visit No. 3 (June 10 to 15).

The firm began purchasing its receipts on a quality basis on June 1, 1912, consequently shrunken eggs were included in the breaking stock as well as small, cracked, and dirty eggs. The checks constituted 40 per cent of the eggs broken.

The candlers were doing painstaking work as usual; the girls, as a whole, were breaking the eggs in a remarkably clean manner. The breakers had been instructed to change all apparatus after eggs put into the second-grade product. This precaution was necessary in order to prevent contamination of the No. 1 product, since samples of the second grade taken on the last visit proved to be heavily infected.

Three series of samples taken at random from the different grades at one breaking table proved, as illustrated in Table 21, that in all but one case whites, yolks, and whole eggs graded as firsts had a low bacterial content. The one exception was sample No. 4511, prepared from eggs not separable into white and yolk. This specimen showed 14,000,000 bacteria per gram and 0.0029 per cent ammoniacal nitrogen on the wet basis. These results are higher than those ordinarily found in food egg and indicate the presence of eggs which should have been put into the second-grade product. The latter, as given in Table F–V (Appendix, p. 84) and Table 21, showed deterioration, both bacteriologically and chemically, as would be expected from the low quality of the eggs used. These results, with the exception of sample No. 4511, indicate that the grading in the breaking room was being done fairly well.

Samples taken from component parts of the second-grade product gave the following results: 47,000 and 1,900,000 bacteria per gram in two lots of drip; 210,000,000 in whites and 26,000,000 in yolks of eggs with light-green albumens; and 440,000,000 in "beginning sour" eggs. The latter contained an amount of ammoniacal nitrogen comparable with that found in tanners' egg. These data amply explain the cause of the low quality of the second-grade eggs.

Two samples representing 400 pounds of commercial liquid yolks had less than 500,000 organisms to the gram. An examination of similar yolks, before and after secondary drying, showed the astoundingly high counts of 110,000,000 and 95,000,000, respectively. A third sample had a similar bacterial content. A laboratory examination of mixed egg from the churn disclosed 1,000,000 organisms to the gram; the same test applied to nine samples of dried mixed egg proved that 44.4 per cent of the counts were 39,000,000 or over. These results point conclusively to multiplication of bacteria during the process of desiccation.

Visit No. 4 (July 1 to 6).

Owing to a shortage in receipts, the firm was breaking firsts in addition to the regular breaking stock. The latter now consisted of 22.1 per cent firsts, 41.5 per cent seconds, and 36.3 per cent checks.

The firm had elaborated the system of checking the work of individual workers so that the errors of candling were reduced to a minimum. Not only were good eggs

saved, but bad eggs, detectable by the candle, were practically eliminated from the shell eggs used for food purposes.

The girls were doing exemplary work. The fact that laboratory results proved that portions of the No. 1 product contained eggs which properly belonged in the No. 2 liquid eggs, or perhaps tanners' grade, was not to their discredit, because of the practical impossibility of making three grades of eggs.

A sixth series of samples taken from the grading tables showed irregular results. The whites contained 29,000 bacteria, as compared with 5,300,000 in the yolks. The soft eggs, however, had only 130,000, which number proved that these eggs were being graded carefully. The sample of second-grade eggs showed considerably less infection and less decomposition than usual; the bacterial content was 10,000,000 per gram, and the percentage of ammoniacal nitrogen was 0.0052 on the dry basis. The chemical analysis also proved that this product contained 84 per cent of drip, or albumen. The latter always gives a low percentage of ammoniacal nitrogen and, in many cases, low bacterial counts. Three samples of drip taken during this interval gave the variable counts of 10,000, 240,000, and 13,000,000 per gram.

In order to determine the cause of the high counts observed in the dried product prepared on the previous visit, seven samples of mixed egg before drying were taken. The laboratory examination gave, as shown in Table F–III, a minimum number of 700,000 and a maximum of 3,700,000 per gram. In no case was the percentage of ammoniacal nitrogen excessive. It would appear from these results that the bacterial content of the liquid stock did not account for the large numbers found in the desiccated product. Six samples of dried yolks and 11 of desiccated mixed egg gave, as shown in Tables F–II and F–IV (Appendix, pp. 81 and 83), in all but three cases, counts varying from 14,000,000 to 200,000,000 per gram.

Three series of samples taken of the product before and after drying showed, in two cases, as given in Table F–VI (Appendix, p. 85), under visit No. 4, a considerable multiplication of bacteria in the eggs during desiccation, the counts increasing from about 1,000,000 to 36,000,000 and 50,000,000 per gram. There was no apparent increase while the egg was subjected to the process of secondary drying.

The foregoing data indicate that the high counts found in some of the samples of the final dried product were due to the development of bacteria in the liquid egg during desiccation. The preparation of dried eggs was discontinued shortly after this visit, hence the study of the conditions leading to the increased number of organisms during desiccation could not be continued in this plant.

Visit No. 5 (July 22 to 27).

The fifth visit to this house was made during the week beginning July 22, 1912. The breaking stock was composed of about one-half firsts and one-half a mixture of seconds and checks.

There was a large number of badly deteriorated eggs in receipts, due to the hot July weather. The candlers, with few exceptions, were doing good work. The breakers were handling the eggs in a clean manner and, to all appearances, were grading the eggs properly.

Two series of samples representing egg as it left the breakers, as recorded in Table 21, gave the usual variable results. The counts of the white and yolk in the first series were higher than was found in any two similar samples taken during the season of 1912, over 7,000,000 per gram. The fact that the laboratory found no *B. coli* in the whites and only 10 in the yolks indicates that the technic of breaking was clean. The large number of bacteria may, perhaps, be accounted for by the low quality of July receipts. The soft eggs contained half as many and the second grade practically the same number of organisms as were found in whites and yolks. The percentage of ammoniacal nitrogen was slightly higher in the second-grade product than in the soft eggs. A second series of samples gave results very different from those just described. The whites and yolks contained comparatively few organisms, but the soft eggs and the second-grade product, on the other hand, had 63,000,000 and 92,000,000, respectively. The amount of protein decomposition in the two latter samples was large, as would be expected from the high counts above. The two series of samples taken on the same day, but from different tables, illustrate well the irregularity of the grading. The girls were conscientious, experienced egg breakers. The results, therefore, show very strikingly the practical impossibility of commercially making two uniform grades of food egg.

Table F–VII (Appendix, p. 86) gives the laboratory results of nine samples of sugared yolks taken from the mixing churns. Some of the lots were broken from firsts, others from seconds, and still others from a mixture of firsts, seconds, and cracked eggs. The lowest count was 34,000 from firsts and the highest 2,400,000 from checks.

Intermediate numbers of bacteria were obtained from the yolks broken from a mixture of the different classes of eggs. The chemical analysis in all cases indicated but a small amount of protein decomposition.

Six samples of soft egg from the mixing churns and buckets contained, as shown in Table F–VIII (Appendix, p. 87), large numbers of organisms in three cases and a comparatively low number in the others. The percentage of loosely bound nitrogen in these samples varied with the bacterial count; two samples, for instance, containing 950,000 and 63,000,000 organisms per gram, had 0.0018 and 0.0031 per cent ammoniacal nitrogen, respectively, on the wet basis. The latter amount is not ordinarily found in food eggs.

In order to study the various classes of eggs making up breaking stock, lots of 15 dozen each were broken in a clean manner by expert graders. The counts were less than 25,000 in two portions of firsts, under 110,000 in two lots of seconds, and 2,200,000 in one sample of checks. The amount of ammoniacal nitrogen in all of the samples was in accordance with that found in good food eggs. It would be expected that the counts would be low in the firsts, somewhat higher in the seconds, and still greater in the hot-weather checks. Since all receipts become lower in quality as the season advances, the July firsts are not comparable with April firsts. For this reason the percentage of ammoniacal nitrogen is lower in April than in July eggs.

Visit No. 6 (August 12 to 17).

The sixth trip to this plant was made during the week beginning August 12, 1912, when, owing to the lateness of the season, the receipts had decreased considerably. The management was now breaking 51.9 per cent firsts, 27.9 per cent seconds, and 20.2 per cent checks. On account of the extreme warm weather the egg supply contained a large percentage of low-grade eggs, among which were many blood rings and eggs with broken yolks.

The vitelline membranes were so weak that it was a difficult matter to separate the eggs into white and yolk, consequently the larger proportion were canned in the form of whole eggs.

The bacteriological and chemical results of four samples taken from the breaking tables proved, as shown in Table 21, that the grading was done accurately. The counts of whites, yolks, and soft eggs were reasonably low and that of the second-grade product very high.

The bacterial content of four samples of sugared yolk was low except in one case (Table F–VII). Since a large percentage of the output now consisted of whole eggs, several samples were taken of this product after it was mixed in the churns. Table F–IX (Appendix, p. 88) shows that the count was not unusually high in any case and that the percentage of ammoniacal nitrogen was in accordance with the amount found in good breaking stock.

A laboratory study was made of nine samples of liquid egg broken from three different classes of eggs making up the breaking stock. The eggs were broken in the packing house in a clean manner and graded carefully. From a bacteriological and chemical viewpoint the quality of the liquid product was very good, with the exception of two samples of cracked eggs and seconds (Nos. 4904 and 4908). The data substantiating this conclusion are correlated in Table 22.

TABLE 22.—*Different classes of eggs used for breaking stock (F house, 1912, visit No. 6).*

Sample No.	Description of sample.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Ammoniacal nitrogen (Folin method).		Moisture.
			20° C.	37° C.		Wet basis.	Dry basis.	
						Per. ct.	*Per. ct.*	*Per. ct.*
4904	Seconds, 30 dozen	Aug. 5	5,000,000	5,100,000	100,000	.....	.....	71.41
4905	....do	....do	600,000	600,000	1,000	.....	.....	70.98
4908	Cracked eggs, 30 dozen	....do	4,300,000	4,260,000	1,000,000	0.0021	0.0064	67.33
4909	....do	....do	850,000	800,000	10	.....	.....	71.60
4912	Current receipts, 30 dozen	....do	7,000	6,500	1,000	.0016	.0060	73.32
4915	Current receipts, 12 dozen	Aug. 6	240,000	240,000	100	.0016	.0057	72.05
4916	....do	....do	17,500	0 at 1,000	10	.....	.....	.....
4944	.....	Aug. 8	400,000	36,500	100	.....	.....	.....
4936	.....	Aug. 7	450,000	420,000	10	.0015	.0053	71.62

CONDITIONS OBSERVED IN D HOUSE DURING TWO CONSECUTIVE YEARS.

Season of 1911.

CONSTRUCTION, EQUIPMENT, AND ROUTINE.

D house installed during the winter of 1910–11 a breaking room, which at this time was the only one of its kind in the country. (Pl. VIII, fig. 2.) The room was 22 by 28 feet. It was insulated with cork on the two outer walls and shavings on the two inner walls. The five windows in the room were insulated with five glasses and four air spaces, the outer pane being of prism glass. The entire room was of concrete construction, the floor being covered with nonabsorbent paint, the walls and ceilings with white enamel. The temperature varied from 60° F. to 65° F. The door of the room opened into a passageway which was divided off at one end for a wash room. The sink was equipped with steam table as well as hot and cold water, and wire racks for draining apparatus.

The breaking tables (Pl. VIII, fig. 2) consisted of gas-pipe frames with slate tops. Resting firmly on these were galvanized iron stands, also with slate tops, holding the small breaking trays at a proper height for convenient work. (Pl. X, fig. 2.) The breaking pans were tin, about 1 foot square and about 3 inches deep. A groove at the top of the pan held a tin-bound piece of one-half-inch mesh wire cloth. Across this wire cloth, and separated by two tin uprights about 3 inches high, was stretched tightly another piece of heavy tin, thereby dividing the top of the tray into two halves. On this piece of tin, which was sharp, the eggs were broken. Sherbet cups were used to receive the eggs. The whites and yolks were separated by the shell method.

The liquid egg was collected in cream pails holding 30 pounds. These, when filled, were emptied into a galvanized churn with a capacity of 200 pounds and mixed by hand with a perforated metal dasher. The mixture was drawn off by means of a creamery faucet into 25-pound tin cans and immediately transferred to the freezer. Only one grade of food egg, and no tanners', was prepared.

At first all cans and utensils were washed and steamed for one minute or less on the steam table whenever changed. Near the end of the season a creamery sterilizer was provided, then all utensils were steamed for 15 minutes at 212° F. The girls wore uniforms and caps. Paper towels were used for drying fingers. All the eggs were chilled before candling in a refrigerated room. The supply of eggs from the candling to the breaking room was practically continuous, hence there was no time for deterioration between candling and breaking. About 15 filled buckets stood overnight to supply the breakers early in the morning. No egg cases were taken into this room, but galvanized buckets holding 12 dozen eggs each were substituted, because they were far more cleanly. The whites and yolks were separated by the shell method.

The force consisted of one foreman, five to ten breaking girls, one or two women to wash apparatus, one messenger boy, and two candlers. Approximately 26,000 pounds of frozen eggs were prepared in a week.

COMPARISON OF COMMERCIAL AND EXPERIMENTAL SAMPLES.

Table D–I (Appendix, p. 94) gives the laboratory results on 38 samples of white, yolk, and mixed egg prepared under the conditions just described. Twenty-four of the number, or 63.2 per cent, had a bacterial count below 1,000,000 per gram and the rest were under 5,000,000. The quantitative tests for *B. coli* never showed over 100,000 per gram, and in many cases the number was considerably lower. The small amount of ammoniacal nitrogen found in the different samples showed that the eggs entering the product were of good quality. The laboratory findings confirmed the impressions gained by the observation of the routine in use, namely, that the management was handling the egg according to the best methods known at that time.

Table 23 gives five series of experiments showing the difference in bacterial contamination of eggs broken commercially from clean seconds as compared with the product obtained in the same manner from dirty eggs. All of the eggs used were of about the same freshness as shown by the uniform quantity of loosely bound nitrogen in the different samples. Variation in quality, therefore, could have no influence in these tests on the bacterial counts. The results in four out of five cases show that the organisms were present in much larger numbers in the product from the dirty eggs, although all the counts were fairly low. The *B. coli* in the majority of the tests were also more plentiful in the liquid from the dirty eggs.

TABLE 23.—*Clean eggs compared with dirty eggs (D House, 1911).*

Sample No.	Description of samples.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.	Ammoniacal nitrogen (Folin method, wet basis).
			20° C.	37° C.			
	Whole egg:	1911.					*Per cent.*
243	Clean shells	July 12	29,500	100,000	10		0.0017
244	Dirty shells	do	19,000	67,000	10	2,000	.0017
234	Clean shells	July 11	4,900	3,600	1,000		.0017
235	Dirty shells	do	190,000	140,000	100		.0017
353	Clean shells	July 24	(1)	68,000	100		.0018
354	Dirty shells	do	1,700,000	2,100,000	100,000		.0016
373	Clean shells	July 25	10,500	(1)	0	10,000	.0019
374	Dirty shells	do	960,000	810,000	10,000	210,000	.0016
385	Clean shells	July 26	77,000	240,000	1,000		.0018
386	Dirty shells	do	4,700,000	3,000,000	1,000,000		.0020

[1] Sterile at 1,000.

The same differences in bacterial count were observed in the drip collecting in the bottom of the tray after breaking clean and dirty eggs. These results are given in Table 24.

TABLE 24.—*Drip in breaking tray from clean and dirty eggs (D House, 1911).*

Number.	Description of samples.	Date of collection.	Bacteria per gram on plain agar incubated at room temperature.	Gas-producing bacteria per gram in lactose bile.
	I.			
375	Clean eggs	July 25, 1911	24,500	
376	do	do	32,500	
387	do	July 26, 1911	95,000	1,000
388	do	do	81,000	10,000
	II.			
377	Dirty eggs	July 25, 1911	450,000	
378	do	do	410,000	
389	do	July 26, 1911	1,600,000	100,000
390	do	do	600,000	1,000

A SPECIAL STUDY APPLYING INFORMATION OBTAINED DURING THE SUMMER OF 1911 TO A WELL-EQUIPPED HOUSE.

The construction of the room in D house was excellent and the equipment good. Cleanliness could be maintained and the work people were flexible. It seemed desirable, therefore, to put into practical operation in this house the information on the handling of frozen eggs that had been gathered during the course of investigations in 1911. The first week of September, 1911, was chosen for this series of experiments. The weather in that section of the country had been very hot and humid, and the deterioration of the egg supply had hastened accordingly. It was the season also for the tall weeds to fall, hence many stolen nests were discovered and their contents sent to market. These factors combined to give a supply of eggs that were very difficult to grade, and the loss in both the candling and breaking rooms was heavy.

The candlers and breakers have an inherent tendency to keep the records of losses as low as possible, thinking that they are benefiting their employer thereby, hence the candler will pass eggs that should be discarded, and the breaker, after throwing away a certain number, will begin to save eggs that she would not have used had their number been fewer. This condition prevailed in D house at the time of the experiments and was caused by the sudden influx of low-grade eggs. It was necessary, therefore, to

supervise the work of the candlers and the grading of the breakers as well as to instill the fundamentals of bacterial cleanliness into the people cleaning the apparatus.

A dairy sterilizer had been installed and it was found that 20 minutes at 210° F. was sufficient to render cups, cans, and breaking knives sterile. All apparatus coming in contact with the egg was, therefore, subjected to this treatment. The churn in which the eggs were mixed and the pails in which the liquid egg was collected were sterilized at noon and again at night to be in readiness for the work of the next morning.

It was observed that many of the eggs had very weak yolks and some had cloudy whites, but the greatest number of rejects were broken-down blood rings. These eggs were difficult to grade and were in such large proportion that the breakers became lax in grading, as stated before. Utensils were clean, but the hands of the breakers were wet and their manipulation of the egg was not exact.

The samples in the first section of Table 25 were taken when the conditions just described prevailed. The ammoniacal nitrogen was not high and the bacterial count varied from 650,000 per gram in the white to 2,300,000 in the yolk. It seemed desirable, however, to investigate the influence on the bacterial count of more careful grading in the breaking room. Samples Nos. 652 to 654, inclusive, show that care in this quarter alone is not enough if there is poor grading in the candling room, as the counts still varied from 220,000 in the white to 1,800,000 in the mixed egg. Three girls were then instructed to handle the eggs in the usual fashion, but to be exceedingly careful to eliminate every doubtful egg and to replace soiled with clean apparatus whenever an egg was discarded—a precaution which had sometimes been neglected because of the number of discards. The work of each of these girls was tested separately. The number of bacteria in the product prepared by them was low, as is evidenced in samples Nos. 661 to 666, inclusive, the counts exceeding 1,000 per gram in only two cases, and these not exceeding 310,000.

Later in the same day the supply of eggs coming from the candling room was plentifully sprinkled with undesirable eggs—stuck spots, broken yolks, disintegrated blood rings, etc. With such a supply two of the girls were instructed to handle the eggs as accurately as possible, cracking sharply, turning quickly to prevent leakage, emptying shells neatly, and keeping fingers clean and dry by means of tissue paper. The results are given in samples Nos. 668 to 671, inclusive. The counts are high; in fact, that of 18,000,000 in the white is far beyond any other count in the whole series and can not be explained by any observed condition. With a better class of eggs, though the work of the candlers was still unsatisfactory, samples of yolk, white, and mixed egg, handled in as cleanly a manner as the girls were capable of, gave the results shown by samples Nos. 672 to 674, inclusive, the mixed egg running up to 1,700,000 bacteria per gram.

Closer attention to grading in the breaking room resulted in the elimination from the output of the house of many eggs that were considered "doubtful." They were collected in a clean pail and examined. Samples Nos. 656, 679, 680, and 681 show that the number of bacteria was, in all but sample No. 680, decidedly above that usually observed, varying from 1,600,000 to 19,000,000. The loosely bound nitrogen was not high. The eggs going to make up these samples had soft yolks, disintegrated and bleached blood rings, milky whites, yolks so heavily settled that they were almost adherent, and almost all of them showed evidences of having had wet shells. The hot, humid weather, and eggs from stolen nests would seem sufficient reasons to account for the presence of these deteriorated eggs and their number.

Improvement on the part of the candlers was now demanded. Their first efforts, supplemented by careful grading and handling in the breaking room, were encouraging, as indicated by samples Nos. 675 to 678, inclusive, where the output of only one breaker contained enough organisms to be worthy of consideration, that is, 2,200,000 per gram, the others varying from less than 1,000 to 64,000.

Still more exactness on the part of the candlers, as well as better receipts, and the same care, with the better work that practice in the cleanly way of holding the egg gave to the breakers, yielded the output samples in the series Nos. 682 to 690. The total number of organisms was reduced to less than 1,000 per gram, except in two specimens; the organisms of the *coli* group were almost eliminated. The breakers worked steadily and rapidly. With the better grading in the candling room the loss of time, due to changing soiled for clean apparatus, washing hands, etc., was saved, and the judgment of the breaker when accepting an egg as satisfactory was more trustworthy.

TABLE 25.—*Experimental breaking and grading (D house, 1911).*

Sample No.	Source and description of sample.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.	Ammoniacal nitrogen (Folin method).		Moisture.	Ether extract.
			20° C.	37° C.			Wet basis.	Dry basis.		
	DOUBTFUL GRADING IN BOTH CANDLING AND BREAKING ROOM.									
	Seconds:						*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
649	Whites	Sept. 6	650,000	280,000	10,000	130,000	0.0002			
650	Yolks of No. 649	do	2,300,000	2,000,000	1,000	190,000	.0020	0.0047	57.82	21.30
651	Mixed egg (very low-grade seconds)	do	1,100,000	1,200,000	100,000	140,000	.0015			
659	Mixed egg from churn	Sept. 7	1,600,000	1,600,000	100,000		.0016			
660	Yolks	do	1,100,000	1,100,000	100,000	120,000	.0031	.0075	58.86	20.79
	GOOD GRADING IN BREAKING ROOM BUT POOR GRADING IN CANDLING ROOM.									
	Seconds (some cracked, some dirty):									
652	Mixed egg	Sept. 6	1,800,000	1,500,000	100,000	110,000	.0016			
653	Do	do	1,800,000	1,600,000	100,000	300,000	.0015			
654	Whites of No. 653	do	220,000	250,000	1,000	0				
	Regular breaking, ordinary candling:									
	Breaker No. 1—									
661	Yolks	Sept. 7	(1)	(1)	1,000		.0023			22.24
662	Whites	do	(1)	(1)	(1)					
	Breaker No. 2—									
663	Yolks	do	30,000	26,000	100	0	.0026	.0063	58.93	21.11
664	Whites	do	310,000	270,000	(1)					
	Breaker No. 3—									
665	Yolks	do	(1)	(1)	(1)		.0018	.0044	58.77	21.09
666	Whites	do	(1)	(1)	(1)					
	Careful breaking, ordinary candling:									
	Breaker No. 2—									
668	Yolks	do	3,500,000	4,200,000	10,000		.0029	.0070	58.34	21.25
669	Whites	do	3,200,000	2,800,000	100,000+					
	Breaker No. 1—									
670	Yolks	do	3,600,000	4,000,000	1,000	750,000	.0024	.0055	56.66	22.50
671	Whites	do	18,000,000	17,700,000	100,000	6,200,000				
	Clean breaking:									
672	Yolks	Sept. 8	56,000	55,000	10,000		.0024	.0058	58.79	22.88
673	Mixed egg	do	1,700,000	1,700,000	10,000	110,000	.0015			
674	Whites	do	20,000	15,500	10,000		.0003			

	GOOD GRADING IN BREAKING ROOM AND IMPROVED GRADING IN CANDLING ROOM.									
	Clean breaking:									
	Breaker No. 2—									
675	Mixed egg	Sept. 8	38,500	43,500	10,000		.0012			
	Breaker No. 1—									
676	Mixed egg	do	2,200,000	2,300,000	(2)	830,000	.0019			
	Breaker No. 3—									
677	Mixed egg	do	(1)	(1)	10,000		.0014			
	Breaker No. 4									
678	Mixed egg	do	64,000	45,500	10,000	0	.0014			
	VERY GOOD GRADING IN BOTH CANDLING AND BREAKING ROOM.									
	Clean breaking—seconds, cracked and dirty eggs:									
	Regular breaking—									
682	Yolks of seconds	Sept. 9	73,000	140,000	1,000		.0021			
683	Whites	do	(1)	(1)	100		.0001			
	Breaker No. 3—									
684	Whites	do	1,200	(3)	(3)	(3)	0	.0004		
685	Yolks	do	(1)	(1)	(1)		.0024	.0058	58.72	22.72
	Breaker No. 2—									
686	Yolks	do	(1)	(1)	(1)		.0032	.0078	58.75	23.22
687	Whites	do	(1)	(1)	(1)		.0001			
688	Mixed egg	do	130,000	76,000	100	40,000				
	Breaker No. 4—									
689	Whites	do	(1)	(1)	(1)		.0001			
690	Yolks	do	(1)	(1)	(1)		.0028	.0065	57.04	24.48
655	Doubtful eggs	Sept. 6		2,800,000	100,000		.0019			
656	Do	do	19,000,000	23,000,000	1,000,000		.0016			
679	Do	Sept. 8	7,400,000	4,600,000	100,000		.0020			
680	Do	Sept. 9	1,600,000	970,000	1,000,000					
681	Do	do	10,000,000	11,000,000	1,000,000		.0020			

[1] Less than 1,000.

[2] Less than 10,000.

[3] Less than 100.

Season of 1912.

CHANGES IN CONSTRUCTION AND EQUIPMENT.

The construction and equipment of D house needed but little further alteration to bring it into accord with the information gained during the previous season. One of the most important additions in equipment made during the season of 1912 was the installation in the breaking room of a sanitary washbowl with running water. This convenience saved considerable time, because formerly whenever a girl broke an infected egg she had to go outside of the room to wash her hands.

In the season of 1912 the passageway outside the breaking room was converted into an anteroom opening into the breaking room on one side and into a newly constructed freezer on the other. The wash room, which formerly occupied this passage, was transferred to a large storeroom into which the third door of the anteroom opened. The fourth door of the anteroom led to a toilet room for the breakers.

The new freezer was well insulated, the walls and ceiling were enameled white, and the floor was made of hard maple. Along two sides of the room were brine-pipe racks on which the 30-pound cans of liquid egg were set while freezing. One side of this room is pictured in Plate XIII, figure 1. The proximity of this freezer to the breaking room greatly facilitated the disposal of the eggs after they were broken.

CONDITIONS PREVAILING EVERY THIRD WEEK FROM APRIL TO SEPTEMBER.

Visit No. 1 (May 6 to 11).

At this time the breaking stock consisted of small, cracked, and dirty eggs sorted from the current receipts of this house and other houses within convenient shipping distance.

On the first day of the visit the eggs were not being candled. It was observed that the girls in the breaking room were annoyed by the frequency of the bad eggs which could have been eliminated by candling. The management on the next day began candling the eggs bought from other houses for breaking purposes. This change in routine, however, only partially corrected the trouble in the breaking room, because the work of the candlers was inefficient and because the current receipts of D house were not graded before going to the breakers.

Most of the egg breakers had worked the previous season, consequently they had received the benefit of the week's training in September, 1911, when they were taught the principles of bacterial cleanliness as applied to the handling of a food product and as far as possible the essential points to be observed in the grading of eggs out of the shell. These instructions were codified and a written copy given each girl to be followed by her in her work during the ensuing season. Their observance had considerable influence on the cleanliness of the product. In substance the rules were as follows:

1. Hands and uniform must be kept clean.
2. Do not use any apparatus coming in contact with food egg unless it has previously been both washed and sterilized.
3. *Breaking the eggs.*—Grasp the egg with the thumb, first and second fingers of the right hand. Give the egg a quick blow on the sharp part of the knife with sufficient force to make an even cut just through the shell and its membrane. Quickly turn the crack upward so there will be no leakage from the egg while it is being transferred from the knife to the cup. With the first and second fingers on the ends of the egg, use the tips of the thumbs to pull the two halves of the shell apart. To empty the shell turn each half directly upside down so that they do not touch each other and drain for the length of time to count one, two, three. Do not let the cups touch the knife.
4. *When separating white from yolk*, have three cups on the tray. Put two on the side which gets the best light, far enough back to be able to crack the eggs on the knife well beyond the cups. Put the other cup on the other side of the tray behind the breaking place on the knife. Put the white into the first cup, the yolk into the second. The other cup on the opposite side is for soft or doubtful eggs. Never separate dirty eggs by the shell method.
5. *Drying fingers.*—Only the tips of the fingers should touch the eggs. They should be dried frequently on tissue paper.
6. Use two cups and, unless bad eggs are prevalent, put two and no more into each cup before emptying.
7. *Smell* and look at every cup of eggs carefully before emptying.
8. *When emptying cups*, pour out eggs, then touch edge of cup against inside of can at least 2 inches below the rim. Do not, therefore, fill cans too full.
9. *Eggs to be discarded.*—Musty, moldy, and sour eggs, eggs with a bloody or green white, mixed rots, eggs with a stuck yolk, white rots, and eggs with a bad odor.

10. *Cleaning after a bad egg.*—Remove all pieces of apparatus with which the egg has come in contact and wash hands before getting clean equipment. For instance, if the infected egg has reached the cup, a recently sterilized knife and cup will be required, or, if the egg spattered on the tray, the entire outfit will have to be replaced. When a bad egg is present in the cup with good ones, all must be thrown away. Spooning or pouring out what can be seen of a bad egg is not allowed.

11. Have cups, knives, trays, churn, and collecting buckets washed and sterilized at noon and again at night.

12. Never break eggs while the room is being swept or for one hour afterwards.

The girls, eight in number, were apt, intelligent, and desirous of learning the underlying principles involved in the preparation of clean, wholesome canned eggs. Their work at this time was good except in one detail—they were not washing hands after every discarded egg, an excusable omission, because they had to go through two doors to get to running water. This inconvenience was obviated when the sanitary washbowl was installed.

A few minor pieces had been added to the list of breaking equipment. For example, screens for the bottom of the egg pails; racks for the handling of the cups in and out of the sterilizer, etc.; and two removable shelves under each breaking stand, one for clean cups and knives and the other for the same when dirty.

The sanitary conditions in the breaking room were excellent. Laboratory tests showed that all the utensils, after sterilizing according to the regular routine, were sterile and that the air was practically free from bacteria. The latter was controlled by fumigating the room once a week with formaldehyde and potassium permanganate.

This house began to break eggs about April 10. On April 17 three samples from checked eggs were taken. Their bacterial examination showed, as given in Tables D–II and D–III (Appendix, pp. 96 and 98), under this date, the exceptionally low count of 5,100, 100, and 200 organisms per gram for mixed egg, white, and yolk, respectively; and no *B. coli* in the sample of white and only 100 in the other two samples. The amount of ammoniacal nitrogen for the three specimens was identical with that of fresh eggs. On account of prompt handling and cool weather the cracked eggs had not deteriorated previous to breaking.

Similar samples obtained for the most part from cracked eggs were procured during the regular visit in the early part of May when the output per day was one-third more than it was at the time of the preliminary visit. The laboratory results still showed a comparatively low bacterial content, as indicated in Tables D–II and D–III under visit No. 1, but there is observed an increase as compared with the count of the previous samples. The white contained 13,500, the yolk 64,000, and the mixed egg 170,000 organisms per gram. The *B. coli* in each of these specimens numbered 1,000 per gram. There was also slightly more loosely bound nitrogen in the eggs at this period.

The differences in the number of bacteria and the ammoniacal nitrogen in the two lots of samples are almost negligible from a practical viewpoint. They are, however, readily detected by laboratory methods, and are probably due to an increased rate of deterioration in the cracked eggs because of warmer weather.

Visit No. 2 (May 27 to 31).

The second series of observations in this house was made when practically all the additions and changes in equipment had been installed. The sanitary washbowl and the remodeled breaking tray were in operation.

Plate X, figure 2, shows a girl at work with the remodeled apparatus. On her right in a galvanized-iron pail is her egg supply; at her left on the table is the 25-pound cream pail for the liquid egg, and on the floor the can for the shells; in front of her on the breaking stand is the breaking tray. Underneath the stand can be observed the shelves for holding the supply of apparatus. Over the girl's head is suspended a package of tissue paper (not shown in picture) for drying fingers.

The new breaking tray, about 1 foot square and 2 inches deep, consists of a copper pan for the drip, a wire screen for supporting the cups, and a breaking knife of boiler steel, the different parts being arranged as pictured in Plate X, figure 2. The pan is tinned on the inside. The ends of the blade are so beveled that they fit into V-shaped openings in the two uprights on the screen. One end of the upper side of the knife is sharpened for about 3 inches. An egg can be broken on this edge without splintering the shell and with very little leakage from the crack while the egg is being transferred from the knife to the cup.

This firm began buying its eggs on a "quality basis" on the 1st of June. The lots coming in during the earlier part of the day were taken to the candling room, which was now under refrigeration and immediately graded; those received late in the afternoon were kept over night in a chill room at about 32° F. and candled the next day

All of the eggs, however, would have been chilled 24 hours before they were graded but for the fact that many of the vendors insisted on payment on the date of the sale.

The present system of buying insured the grading of all eggs going to the breaking room. The breaking stock now included shrunken eggs candled out of receipts as well as small and cracked eggs. On account of the dry weather there were not many dirty eggs at this time. There were but few badly deteriorated eggs in the supply, consequently the work in the breaking room was not materially affected by the kind of work done in the candling room.

The maximum daily output of canned eggs at this time was practically the same as the first week in May. The weather had not yet become sufficiently warm to produce many seconds; therefore, the supply of eggs for breaking purposes was chiefly small, dirty, and cracked eggs.

In two experiments in which both the white and the yolk of the egg were examined, the bacterial count, as given in Table D–III, visit No. 2, (Appendix, p. 98), was not higher than similar samples taken in April and early May. The third pair of samples had in the white 1,500,000 and in the yolk 950,000, a considerably higher count than has been observed heretofore. The *B. coli* also had increased decidedly. The higher count in these samples may be due to the fact that clean and dirty eggs were sent together to the breaking room. The girls who were separating by the shell method were instructed not to break dirty eggs, but they, of necessity, had to handle them and, therefore, fingers were soiled. The fact that there were more bacteria in the white than in the yolk lends color to this inference. Previously, when the dirty eggs were more plentiful, the candlers sorted them into lots by themselves and they were broken for mixed egg.

Three samples of mixed egg from seconds, as recorded in Table D–II, under visit No. 2, (Appendix, p. 96), had a minimum bacterial content of 320,000, a maximum of 950,000 organisms per gram, and a range in the number of *B. coli* from 1,000 to 10,000. These counts are considerably higher than any found in previous samples; the amount of loosely bound nitrogen had also slightly increased.

Twelve samples of mixed eggs taken each working day during the interval between the second and third visit (see Table D–II, under dates May 29 to June 15, inclusive), showed no material increase in the bacterial content and no change in the ammoniacal nitrogen. In fact, many of the counts were lower. Six of the samples contained less than 400,000 bacteria per gram; the number in the other six was not over 2,200,000. The maximum count of this series of experiments was higher than has been found in samples taken at an earlier date, but the average was about the same.

Visit No. 3 (June 17 to 22).

The third visit was made between the dates June 17 and 22, inclusive, when, owing to prolonged cool weather and a shortage in the egg supply, there were few seconds to be used for breaking. The number of girls in the breaking room had been reduced from eight to four, and often they worked for only part of a day. The eggs were of good quality, so the grading was comparatively simple. A tanners' grade was being made of the discards in the breaking room. The preparation of this grade, however, was soon abandoned.

At this time there were obtained eight samples of food egg, of which five were whites and three yolks. The laboratory examination showed that neither the bacterial count nor the amount of ammoniacal nitrogen had increased when compared with the results obtained from similar samples taken previously.

Three samples were also taken of the tanners' eggs, which, as would be expected, were heavily infected with bacteria, the number aggregating, in some cases, more than 100,000,000 per gram. The high amount of ammoniacal nitrogen, about treble that found in the food eggs at this time, indicated to what degree the material had deteriorated. These results are given in Table 26.

TABLE 26.—*Commercial samples of tanners' liquid egg—Discards from breaking room (D house, 1912).*

Sample No.	Visit.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.	Ammoniacal nitrogen (Folin method).		Moisture.	Size of sample.
			20° C.	37° C.			Wet basis.	Dry basis.		
							Per ct.	*Per ct.*	*Per ct.*	*Lbs.*
4555	3	June 17	110,000,000	56,000,000	1,000,000	20,000,000	0.0047	0.0156	69.82	30
4561	3	...do....	150,000,000	68,000,000	10,000,000	60,000,000	.0055	.0157	65.06	35
4569	3	June 18	39,000,000	20,000,000	1,000,000	6,000,000	.0039	.0124	68.73	70

Some experiments were conducted during this week to check the cleanliness of the routine of the breaking room. For this investigation four samples of eggs in the shell were procured—one of clean seconds, one of cracked eggs, and two of dirty eggs. The samples, consisting of 12 dozen eggs each, were divided equally into two portions. One was broken commercially in the packing house, and the other was opened aseptically in the laboratory. These comparative experiments, listed in Table 27, not only indicate the superior quality of the breaking stock at this season, but also show how closely the aseptic methods of the laboratory can be approximated under commercial conditions.

TABLE 27.—*Comparative samples of eggs opened commercially and aseptically (D house, 1912).*

[Samples collected June 19, 1912.]

Sample No.	Description and size of sample.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.	Ammoniacal nitrogen (Folin method).		Moisture.	Number of discards.	Method of opening.
		20° C.	37° C.			Wet basis.	Dry basis.			
	Visit No. 3.					*Per ct.*	*Per ct.*	*Per ct.*		
4572	Cracked, 6 dozen	140,000	75,000	0	.....	0.0019	0.0071	73.22	2	Commercial.
4573	.....do.....	200	350	0	.....	.0018	.0065	72.09	1	Aseptic.
4585	Leakers of No. 4573, 1½ dozen.	200	100	0	.....	.0019	.0068	72.03	0	Commercial.
4578	Clean seconds, 6 dozen.	600	300	0	0 in 1,000	.0016	.0059	73.00	0	Do.
4579	.....do.....	0	0	0	0 in 1,000	.0017	.0061	72.13	2	Aseptic.
4576	Dirty, 6 dozen...	400	400	10	0 in 1,000	.0017	.0065	73.85	0	Commercial.
4577	.....do.....	200	50	0	0 in 1,000	.0017	.0061	72.29	0	Aseptic.
4581	.....do.....	13,000	3,000	1,000	2,000	.0017	.0063	72.87	0	Commercial.
4582	.....do.....	150	0	0	0 in 1,000	.0017	.0061	72.02	.....	Aseptic.

Visit No. 4 (July 9 to 12).

During the interval between the third and fourth visits the weather had been warm, with the result that the percentage of seconds in receipts increased and many of the fertile eggs contained hatch spots or blood rings. A typical heated egg is pictured in Plate II, U. S. Department of Agriculture Bulletin No. 51. On account of inefficient candling many blood rings found their way to the breaking room, thereby increasing the difficulties of grading as well as necessitating frequent changes of apparatus.

This poor work led one to suspect that the candlers might be just as careless in throwing away edible eggs as they were in not eliminating the bad eggs. That this suspicion was well founded is shown by the fact that when two cases of discards from the candling room were broken one contained 9.7 per cent food eggs and the other the astonishingly high percentage of 29.4 per cent. This was too great a loss to be passed unnoticed, therefore the candling foreman was instructed to recandle daily the eggs discarded by the different candlers. This work was a part of the candling room routine for the remainder of the season.

Up to the present time the girls had worked practically without supervision and according to the instructions given them at the beginning of the season. Now, in order to train new girls and on account of the increased difficulty in grading, one of the cleanest and most experienced egg breakers was given charge of the room. Her duties were as follows:

1. Enforce instructions to breakers.
2. Supervise washing and sterilizing of apparatus and supply of same to breaking room.
3. If a breaker is dirty, disobedient, unable to grade, or inefficient, consult with the management regarding her discharge.
4. If candling is not satisfactory, report to the management.
5. Decide on doubtful eggs.
6. Supervise cleaning of breaking room, toilet room, hallway, and wash room.

Samples taken during this visit and also those taken by an employee of the plant during the investigator's absence showed practically no change in the bacterial count or the amount of ammoniacal nitrogen of the commercial product. Previous work on hatch-spot eggs proved them to be nearly sterile when opened aseptically and to contain low quantities of ammoniacal nitrogen. Therefore one would not expect that the presence of a large percentage of these eggs in the breaking stock would materially affect either its bacterial content or its chemical composition.

Visit No. 5 (July 29 to August 2).

The fifth series of observations was made when, owing to a prolonged period of hot weather, there was an increased supply of eggs for breaking. Many of the eggs were distinctly lower in quality than the breaking stock previously used. The regular candling room was not large enough to handle all the eggs, therefore an auxiliary candling room was established in one corner of a storeroom. Not being refrigerated, it was very hot. To take care of the extra supply of eggs, new candlers were required. From this fact, together with the increased difficulty in grading such low quality eggs, it could be predicted that large numbers of bad eggs would not be detected and would therefore gain access to the breaking room.

An observation made in the breaking room showed that 41 bad eggs, or 9.5 per cent, were found in a total of 36 dozen. These should all have been eliminated by the candlers. An analysis of the 41 eggs showed that they consisted of 2 eggs containing mold spots, 6 blood rings, 13 white rots, and 20 eggs with an adherent yolk.

The effect of so many bad eggs in the breaking-room stock is shown by the fact that the product broken from the lot of 36 dozen eggs contained 20,000,000 organisms per gram.

An investigation in the candling room showed that the trouble was chiefly ignorance on the part of the new candlers. By working with them for a short time and pointing out which eggs should be saved and which discarded the number of bad eggs in the breaking stock was promptly reduced.

In order to put a check on the work of individual candlers, each man was instructed to place a tag bearing his name on every bucket of eggs candled by him. Under this system the work of an individual candler could be traced into the breaking room. Under this regulation the men worked more cautiously, and as long as this system was in use the work in the candling room was greatly improved.

The girls in the breaking room, now 14 in number, were doing efficient work under the supervision of the new forewoman. The organization previously described, including a forewoman, had been in operation about two weeks. During this time the increased efficiency in the breaking room was equivalent to the wages of the forewoman.

Up to this time one-half of the girls had their egg supply on the left instead of on the right side; observations with a split-second stop watch showed that 1.8 seconds were lost for every four eggs broken when a girl reached for her eggs with her left rather than with her right hand.

Estimating these results on the basis of a 10-hour day, a girl reaching to the right for the eggs could break 1.4 more cases a day than she could when working toward the left. In accordance with these results, all the apparatus on the breaking table was rearranged so that no extra motions were made from the time the egg was removed from the pail until it reached its final container.

The majority of the commercial samples taken during the latter part of July contained not only more bacteria but also more loosely bound nitrogen than did any previous series of samples. For instance, the five specimens of mixed eggs collected during the investigator's absence and the five collected during visit No. 5 had, as given in Table D–II, visit No. 5 (Appendix), an average count of 1,400,000 organisms per gram as compared with 650,000 in the samples taken during the first half of the month. The white and yolk samples showed an even greater increase in bacteria.

During this visit there was received one shipment of 72 cases of checks which showed a combined loss in the candling and breaking room of 14.6 per cent. The bacterial findings given in Table 28 showed that the product from these eggs had a materially higher bacterial content than the regular product. Many of the eggs were moldy. They were obtained from a shipper who had gradually sorted them out of his receipts as unsuited for shipping and had therefore sold them to an egg-breaking establishment.

TABLE 28.—*Commercial samples of low quality, cracked eggs (D house, 1912.)*

Sample No.	Description and size of sample.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Ammoniacal nitrogen (Folin method).		Moisture.
			20° C.	37° C.		Wet basis.	Dry basis.	
	Visit No. 5.					*Per ct.*	*Per ct.*	*Per ct.*
4855	Cracked eggs, 125 pounds....	July 29	6,000,000	5,500,000	100,000	0.0023	0.0075	69.19
4856	....do.....	...do.....	4,800,000	4,000,000	100,000			
4886	Cracked eggs, 100 pounds....	Aug. 1	5,400,000	4,300,000	100,000	.0017	.0062	72.69

A second shipment of checked eggs, which had been in commerce, as was the other shipment cited, but obtained from a different shipper, gave similar results. The product was of lower quality than the average output of this house; hence the purchase of such eggs was promptly discontinued.

Visit No. 6 (August 19 to 24).

The sixth and last visit was made when, owing to the lateness of the egg-laying season, the receipts were very light.

The candlers had become careless because the tag system of checking had been abolished when the force was decreased. The work of the breakers, however, was as good as during the last visit, because the organization and routine of the breaking room was not changed even though the number of girls had been reduced.

The quality of the breaking stock had not improved, consequently the counts of samples procured on the fifth and sixth visits were practically the same; the average count of the 10 samples of mixed egg taken the latter half of July was 1,400,000 per gram; of the same number of samples collected during the visit under discussion, it was 1,700,000 organisms per gram (Table D–II, Appendix, p. 96).

During this visit a gravity type trough separator for whites and yolks was tried. This device did not prove mechanically successful for separating warm-weather eggs. Samples of white and yolk separated by the trough method, both during its experimental stage and after its perfection, gave the counts listed in Table 29. If the results under visits 2 and 5 be compared with the counts for similar periods in Table D–III (Appendix, p. 98), which gives whites and yolks separated by the shell method, it will be observed that in all cases there are fewer bacteria in the samples separated by the trough method. This is particularly true of the number of *B. coli*.

TABLE 29.—*Commercial samples of whites and yolks—Trough method of separation (D house, 1912).*

Sample No.	Description and size of sample.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Ammoniacal nitrogen (Folin method).		Moisture.
			20° C.	37° C.		Wet basis.	Dry basis.	
	Visit No. 2.					*Per ct.*	*Per ct.*	*Per ct.*
4403	Whites, seconds, 15 pounds	May 27	[1] 1,600	150	[1] 0	0.0004	0.0031	87.10
4404	Yolks of No. 4403, 15 pounds	do	[1] 1,200	400	[1] 10	.0033	.0072	54.15
	Visit No. 5.							
4861	Whites, seconds and cracked eggs, 20 pounds	July 29	[2]320,000	190,000	[2] 1,000			
4862	Yolks of No. 4861, 20 pounds	do	[2]100,000	150,000	[2] 1,000	.0030	.0068	56.05
4868	Whites, seconds, 13 pounds	July 30	[2]360,000	330,000	[2] 1,000			
4869	Yolks of No. 4868, 11 pounds	do	[2]110,000	90,000	[2] 0 in 100	.0037	.0083	55.42
	Visit No. 6.							
41005	Whites, seconds, 25 pounds	Aug. 19	27,000	22,000	1,000			
41006	Yolks of No. 41005, 15 pounds	do	300,000	180,000	1,000	.0029	.0067	56.66
41011	Whites, seconds, 18 pounds	do	600,000	650,000	0	.0003	.0023	86.96
41012	Yolks of No. 41011, 13 pounds	do	650,000	600,000	0	.0030	.0065	53.64
41026	Whites, seconds and cracked eggs, 30 pounds	Aug. 20	490,000	360,000	1,000			
41027	Yolks of No. 41026, 30 pounds	do	800,000	650,000	10,000	.0027	.0075	64.06

[1] Comparable figures obtained by the shell method of separation (Table D III, p. 98, Appendix) vary from 15,000 to 950,000 bacteria in the yolks and from 60,000 to 1,500,000 in the whites, *B. coli* varying from 100 to 10,000.

[2] Comparable figures from the same source show a maximum bacterial content of 650,000 for the whites, 2,100,000 for the yolks, and from 100 to 1,000,000 *B. coli*—a pronounced superiority of the trough-separated product.

By the shell method the egg, during the shifting of the yolk from one half shell to the other, is sure to come in contact with the fingers of the breaker and the outside of the shells, both of which, as foregoing statements have proved, are serious sources of contamination. By the trough method the egg, on the other hand, comes in contact with practically nothing except the cup and separator, both of which can be kept clean by frequent sterilizing.

TABULATED RESULTS.

TABLE C–I.—*Commercial samples of whites, yolks, and whole eggs, 1911.*

Sample No.	Description of sample.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.	Ammoniacal nitrogen (Folin method).		Moisture.	Ether extract.
			20° C.	37° C.			Wet basis.	Dry basis.		
	Whites:						*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
187	From 17 pound pail	July 6	240,000	380,000	10,000	2,000	0.0005	0.0037	86.64	.....
189	From 3 pails at end of morning's breaking	...do....	85,000	55,000	10,000	5,500	.....	.....	.....	.....
404	From pail ready for freezer	July 31	160,000	120,000	0 in 1:1,000	4,000	.0005	.....	.....	.....
407	Do	...do....	120,000	58,000	10,000	0	.0006	.....	.....	.....
409	Do	...do....	110,000	65,000	100,000	0	.0005	.....	.....	.....
411	Do	Aug. 1	1,500,000	1,200,000	1,000	.....	.0005	.....	.....	.....
413	Do	...do....	1,200,000	430,000	1,000	500,000	.0004	.....	.....	.....
416	Do	...do....	23,000	18,000	1,000	0	.0003	.....	.....	.....
563	Do	Aug. 21	31,000	17,000	10,000	.....	.0004	.....	.....	.....
566	Do	...do....	44,500	36,000	1,000	.....	.0002	.....	.....	.....
573	Cracked eggs	Aug. 22	330,000	350,000	10,000	200,000	.0002	.....	.....	.....
594	Seconds from pail ready for freezer	...do....	90,000	67,000	1,000	10,000	.0002	.....	.....	.....
	Yolks:									
184	From churn	July 6	270,000	230,000	[1] 10,000	100,000	.0039	.0090	56.48	24.66
185	Sugared yolk from churn	...do....	150,000	200,000	[1] 10,000	40,000	.0037	.0073	49.26	23.01
188	From churn	...do....	630,000	820,000	[1] 1,000	120,000	.0032	.0074	56.74	22.85
402	Sugared yolks from churn	July 31	1,200,000	940,000	1,000	160,000	.0035	.0073	51.85	22.37
406	Do	...do....	1,900,000	900,000	100,000	120,000	.0034	.0072	52.90	21.09
408	Do	Aug. 2	120,000	490,000	10,000	200,000	.0034	.0071	52.21	22.17
410	Do	July 31	460,000	410,000	10,000	30,000	.0036	.0075	52.31	22.35
414	Do	Aug. 1	250,000	230,000	1,000	20,000	.0034	.0071	51.81	23.23
415	Do	...do....	420,000	450,000	10,000	10,000	.0035	.0073	52.33	23.47
564	Do	Aug. 21	320,000	310,000	10,000	200,000	.0028	.0058	51.90	20.76
567	Do	...do....	300,000	270,000	10,000	0	.0029	.0061	52.07	21.07
574	Do	Aug. 22	1,400,000	1,600,000	1,000,000	210,000	.0028	.0060	53.08	22.41
595	Do	Aug. 23	8,000,000	3,700,000	100,000	1,500,000	.0020	.0074	72.95	10.89
	Whole eggs from churn:									
412	First grade	Aug. 2	1,900,000	1,900,000	10,000	.....	.0024	.....	.....	.....
580	Better than a second but not a first grade	Aug. 22	4,500,000	4,900,000	[1] 100,000	260,000	.0018	.....	.....	.....
186	Second grade	July 6	3,300,000	9,500,000	10,000	.....	.0022	.0085	74.16	9.60
403	Do	July 31	12,000,000	11,000,000	[1] 1,000,000	500,000	.0023	.....	.....	.....
405	Do	...do....	5,700,000	2,600,000	1,000,000	130,000	.0024	.....	.....	.....
417	Do	Aug. 2	8,100,000	5,700,000	[1] 100,000	400,000	.0020	.....	.....	.....
565	Do	Aug. 1	6,100,000	6,600,000	[1] 100,000	.....	.0018	.....	.....	.....
568	Do	Aug. 21	790,000	800,000	1,000	.....	.0019	.....	.....	.....

569	Do	do	3,300,000	2,500,000	[1] 100,000	80,000	.0019			
575	Do	Aug. 22	9,200,000	8,500,000	1,000,000	1,000,000	.0020			
593	Do	Aug. 23	300,000	200,000	100,000	40,000	.0025			
596	Do	do	2,000,000	2,000,000	[1] 100,000	10,000	.0018			
183	Tanners' egg and drip	July 6	17,000,000	7,000,000	[1] 10,000	2,100,000	.0023	.0098	76.61	8.41
570	Tanners' egg and drip from 30-pound pail	Aug. 22	27,000,000	19,000,000	1,000,000	3,900,000	.0017			

[1] Number of gas-producing bacteria not determined beyond this number.

TABLE E–I.—*Successive commercial samples of liquid and dried eggs, 1912.*

Sample No.	Description of sample.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.	Ammoniacal nitrogen (Folin method).		Moisture.
			20° C.	37° C.			Wet basis.	Dry basis.	
	Visit No. 1.						*Per cent.*	*Per cent.*	*Per cent.*
4169	Liquid egg from mixer	Apr. 22	700,000	150,000	1,000				
4170	Liquid egg from storage tank	do	430,000	120,000	1,000				
4171	Liquid egg from supply tank to belt No. 3	do	290,000	120,000	1,000				
4177	Dried egg from belt No. 3	do	800,000	1,300,000	1,000	40,000			9.04
4185	Liquid egg from 17 pails	Apr. 25	950,000	20,500	100	30,000			
4186	Liquid egg from mixer	do	900,000	90,000	0	0 in 10,000			68.01
4187	Liquid egg from storage tank	do	140,000	160,000	100	0 in 10,000			
4188	Liquid egg from supply tank to belt No. 5	do	1,500,000	96,000	100	500,000			
4189	Liquid egg after brushes	do	850,000	42,500	10,000	0 in 10,000			
4191	Dried egg after belt No. 5	do	430,000	91,000	0	110,000			7.13
4192	Wet lumps after belt No. 5	do	14,000,000	17,000,000	1,000				18.00
	Visit No. 2.								
4300	Liquid egg from storage tank	May 13	1,500,000	700,000	100,000	450,000	0.0016	0.0054	70.29
4301	Liquid egg from supply tank to belt	do	1,400,000	1,000,000	10,000	400,000			
4302	Liquid egg after brushes	do	1,400,000	1,100,000	100,000	77,000			
4312	Dried egg from belt	do	1,400,000	1,100,000	1,000,000	200,000	.0006	.0007	7.78
4350	Liquid egg from mixer	May 17	1,000,000	120,000	10,000	150,000	.0016	.0058	72.64
4351	Liquid egg from supply tank to belt No. 5	do	1,000,000	220,000	100,000	140,000			
4354	Liquid egg after brushes	do	850,000	180,000	10,000	170,000			
4352	Liquid egg from supply tank to belt No. 4	do	900,000	310,000	1,000,000	160,000			
4359	Dried egg from belt No. 4	do	3,400,000	2,600,000	100,000	2,700,000	.0012	.0013	9.62
4360	Dried egg from belt No. 3	do	900,000	850,000	1,000,000	110,000	.0009	.0010	10.78
	Visit No. 3.								
4439	Liquid egg from supply tank belt No. 1	June 1	3,800,000	1,300,000	100,000	330,000			
4447	Dried egg from belt No. 1	do	4,200,000	1,600,000	100,000	100,000			
4448	Wet lumps from belt No. 1	do	15,000,000	11,000,000	1,000,000	1,200,000			
4440	Liquid egg from supply tank to belt No. 2	do	3,100,000	1,200,000	100,000	350,000			
4449	Dried egg from belt No. 2	do	1,600,000	600,000	100,000	100,000			
4450	Wet lumps from belt No. 2	do	12,000,000	5,900,000	100,000	210,000			

4441	Liquid egg from supply tank to belt No. 3	do	3,300,000	1,700,000	100,000	220,000			
4442	Liquid egg after brushes	do	3,900,000	1,900,000	1,000,000	3,000,000			
4451	Dried egg from belt No. 3	do	4,200,000	1,700,000	100,000	200,000	.0008	.0009	9.89
4452	Wet lumps from belt No. 3	do	3,800,000	1,800,000	100,000	130,000	.0028	.0036	21.48
4443	Liquid egg from supply tank to belt No. 4	do	3,100,000	1,300,000	1,000,000	310,000			
4453	Dried egg from belt No. 4	do	1,300,000	750,000	100,000	150,000	.0008	.0009	9.07
4454	Wet lumps from belt No. 4	do	3,600,000	1,100,000	100,000	300,000	.0011	.0013	17.36
4445	Liquid egg from supply tank to belt No. 5	do	4,000,000	1,400,000	100,000	280,000			
4446	Liquid egg after brushes	do	2,100,000	900,000	100,000	190,000			
4455	Dried egg from belt No. 5	do	1,200,000	900,000	100,000	120,000			
	Visit No. 4.								
4592	Liquid egg from supply tank to belt No. 5	June 24	4,000,000	850,000	100,000	1,000,000	.0020	.0073	72.65
4593	Dried egg from belt No. 5	do	3,400,000	1,100,000	100,000	100,000	.0013	.0014	8.64
4594	Wet lumps from belt No. 5	do	3,900,000	850,000	100,000	1,000,000			
4610	Liquid egg from supply tank to belt No. 5	June 25	1,500,000	260,000	100,000				
	Visit No. 5.								
4738	From pails—2 hours' break	July 15	3,400,000	1,600,000	100,000				
4739	Storage tank	do	4,000,000	1,800,000	100,000		.0021	.0081	74.17
4740	Five supply tanks	do	7,400,000	5,300,000	100,000				
4742	Dried egg from four belts	do	9,300,000	4,200,000	1,000,000				11.30
4743	Wet lumps from four belts	do	11,000,000	7,500,000	1,000,000				21.00
	Visit No. 6.								
4922	Liquid egg from supply tank to belt No. 5	Aug. 6	5,100,000	3,400,000	100,000		.0020	.0073	72.55
4925	Dried egg from belt No. 5	do	5,000,000	2,800,000	1,000,000		.0010	.0011	9.15
4926	Wet lumps from belt No. 5	do	5,000,000	4,800,000	1,000,000				
	Visit No. 7.								
41061	Liquid egg from supply tank to belt No. 5	Aug. 26	19,000,000	5,500,000	100,000		.0031	.0112	72.38
41063	Dried egg from belt No. 5	do	5,800,000	2,100,000	100,000				8.80
41064	Wet lumps from belt No. 5	do	8,200,000	4,100,000	1,000,000				

TABLE E-II.—*Commercial samples of dried egg compared with wet lumps from belt, 1912.*

[See table E-VIII for summary.]

Sample No.	Description of sample.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.	Ammoniacal nitrogen (Folin method).		Moisture.
			20° C.	37° C.			Wet basis.	Dry basis.	
	Visit No. 1.						*Per cent.*	*Per cent.*	*Per cent.*
4191	Dried egg from belt No. 5	Apr. 25	430,000	91,000	.....	110,000	0.0006	0.0007	7.13
4192	Wet lumps from belt No. 5	...do....	14,000,000	17,000,000	1,000	.....	.0024	.0029	18.00
	Visit No. 2.								
4309	Dried egg	May 13	1,300,000	950,000	10,000	80,000	.0009	.0010	10.84
4308	Wet lumps	...do....	9,200,000	10,000,000	100,000	340,000	.0010	.0013	20.54
4315	Dried egg, 93.5 pounds	May 14	850,000	1,300,000	10,000	110,000	.0004	.0004	7.40
4316	Wet lumps, 20 pounds	...do....	1,900,000	2,800,000	100,000	190,000	.0014	.0017	18.79
4325	Dried egg, 96 pounds	May 15	2,000,000	800,000	1,000	190,000	.0007	.0008	10.53
4326	Wet lumps, 6.5 pounds	...do....	2,900,000	1,100,000	10,000	650,000	.0007	.0008	16.46
4335	Wet lumps	May 16	6,300,000	5,100,000	1,000,000	250,000	.....	.....	.....
4355	Dried egg	May 17	800,000	700,000	10,000	16,000	.0008	.0009	9.20
4356	Wet lumps	...do....	6,900,000	6,100,000	1,000,000	.....	.0018	.0023	21.68
	Visit No. 3.								
4447	Dried egg	June 1	4,200,000	1,600,000	100,000	100,000	.....	.....	.....
4448	Wet lumps	...do....	15,000,000	11,000,000	1,000,000	1,200,000	.....	.....	.....
4449	Dried egg from belt No. 2	...do....	1,600,000	600,000	100,000	100,000	.....	.....	.....
4450	Wet lumps from belt No. 2	...do....	12,000,000	5,900,000	100,000	210,000	.....	.....	.....
4451	Dried egg from belt No. 3	...do....	4,200,000	1,700,000	100,000	200,000	.0008	.0009	9.89
4452	Wet lumps from belt No. 3	...do....	3,800,000	1,800,000	100,000	130,000	.0028	.0036	21.48
4453	Dried egg from belt No. 4	...do....	1,300,000	750,000	100,000	150,000	.0008	.0009	9.07
4454	Wet lumps from belt No. 4	...do....	3,600,000	1,100,000	100,000	300,000	.0011	.0013	17.36
4472	Dried egg from belt No. 2	June 3	2,300,000	800,000	10,000	.....	.....	.....	.....
4473	Wet lumps from belt No. 2	...do....	2,700,000	850,000	1,000,000	.....	.0013	.0017	22.01

4474	Dried egg from belt No. 3	do	2,600,000	900,000	1,000,000		.0007	.0008	6.76
4475	Wet lumps from belt No. 3	do	2,100,000	800,000	100,000		.0014	.0018	23.23
4480	do	June 5	4,100,000	2,100,000	100,000		.0011	.0014	20.56
4481	do	do	6,400,000	4,700,000	100,000		.0008	.0009	8.68
	Visit No. 4.								
4593	Dried egg from belt No. 5, approximately 100 pounds	June 24	3,400,000	1,100,000	100,000	100,000	.0013	.0014	8.64
4594	Wet lumps from belt No. 5, a few pounds	do	3,900,000	850,000	100,000	1,000,000			
4614	Dried egg from belt No. 4	June 25	880,000	210,000	1,000		.0015	.0016	7.18
4615	Wet lumps from belt No. 4, a few pounds	do	1,100,000	330,000	10,000				
4618	Dried egg from belt No. 5	June 27	12,000,000	8,400,000	10,000	200,000	.0017	.0019	8.94
4619	Wet lumps from belt No. 5, approximately 7 pounds	do	18,000,000	16,000,000	10,000		.0053	.0067	21.21
	Visit No. 5.								
4731	Dried egg	July 13	4,100,000	2,300,000	1,000,000		.0010	.0011	8.06
4732	Wet lumps	do	9,400,000	6,300,000	1,000,000		.0013	.0016	18.30
4742	Dried egg from 4 belts	do	9,300,000	4,200,000	1,000,000				11.30
4743	Wet lumps from 4 belts	do	11,000,000	7,500,000	1,000,000				21.00
4750	Dried egg from 5 belts	July 16	2,200,000	700,000	100,000		.0016	.0018	8.86
4751	Wet lumps from 5 belts	do	3,400,000	2,000,000	100,000		.0014	.0018	22.90
4788	Dried egg from belt No. 5	July 19					.0016	.0017	8.36
4789	Wet lumps from belt No. 5	do							16.24
	Visit No. 6.								
4925	Dried egg from belt No. 5	Aug. 6	5,000,000	2,800,000	1,000,000		.0010	.0011	9.15
4926	Wet lumps from belt No. 5	do	5,000,000	4,800,000	1,000,000				
4948	do	Aug. 8	4,500,000	1,800,000	1,000,000				8.20
4929	Dried egg	Aug. 7	3,900,000	3,400,000	100,000		.0006	.0006	6.75
4930	Wet lumps	do	5,100,000	8,400,000	1,000,000				19.00
	Visit No. 7.								
41063	Dried egg from belt No. 5	Aug. 26	5,800,000	2,100,000	100,000				8.80
41064	Wet lumps from belt No. 5	do	8,200,000	4,100,000	1,000,000				
41066	Wet lumps	Aug. 27	4,700,000	2,400,000	100,000		.0015	.0016	6.89
41077	do	Aug. 28	14,000,000	14,000,000	10,000		.0010	.0011	6.34

TABLE E-III.—*Commercial samples of desiccated egg from belt, 1912.*

[Flaky dried egg—summarized in Table E-VIII.]

Sample No.	Description of sample.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.	Ammoniacal nitrogen (Folin method).		Moisture.
			20° C.	37° C.			Wet basis.	Dry basis.	
	Visit No. 1.						*Per cent.*	*Per cent.*	*Per cent.*
4177	From belt No. 3	Apr. 22	800,000	1,300,000	1,000	10,000	0.0002	0.0002	9.04
4191	From belt No. 5	Apr. 25	430,000	91,000	0	110,000	.0006	.0007	7.13
4196	do	Apr. 26	1,400,000	160,000	10,000		.0008	.0009	9.70
	Visit No. 2.								
4294	From belt No. 5	Apr. 29	65,000	35,000	1,000	10,000			
4297	Third run	May 6	1,100,000	900,000	10,000	70,000			
4298	First run	May 8	900,000	550,000	10,000	10,000			
4309		May 13	1,300,000	950,000	10,000	80,000	.0009	.0010	10.84
4312	Last run	do	1,400,000	1,100,000	1,000,000	200,000	.0006	.0007	7.78
4315		May 14	850,000	1,300,000	10,000	110,000	.0004	.0004	7.40
4325	From belt No. 4	May 15	2,000,000	800,000	1,000	190,000	.0007	.0008	10.53
4355		May 17	800,000	700,000	10,000	16,000	.0008	.0009	9.20
4359	From belt No. 4; not drying well	do	3,400,000	2,600,000	100,000	2,200,000	.0012	.0013	9.62
4360	From belt No. 3	do	900,000	850,000	1,000	110,000	.0009	.0010	10.78
	Visit No. 3.								
4434	First run	May 26	4,000,000	1,100,000	1,000	200,000			
4433	First run; refrigeration installed on this date	May 27	1,200,000	550,000	1,000	18,000			
4437		May 29	600,000	260,000	1,000	20,000			
4447	From belt No. 1	June 1	4,200,000	1,600,000	100,000	100,000			
4449	From belt No. 2	do	1,600,000	600,000	100,000	100,000			
4451	From belt No. 3	do	4,200,000	1,700,000	100,000	200,000	.0008	.0009	9.89
4453	From belt No. 4	do	1,300,000	750,000	100,000	150,000	.0008	.0009	9.07
4455	From belt No. 5	do	1,200,000	900,000	100,000	120,000			
4472	From belt No. 2	June 3	2,300,000	800,000	10,000				
4474	From belt No. 3	do	2,600,000	900,000	1,000,000		.0007	.0008	6.76
	Visit No. 4.								
4600	From belt No. 3	June 11	550,000	150,000	100,000	110,000			
4601	From belt No. 5; No. 4602 after standing in bin 2 days	June 17	6,000,000	5,400,000	1,000	130,000			
4602		June 15	5,700,000	5,200,000	100,000	100,000			
4603	From belt No. 2	June 17	1,300,000	330,000	10,000	400,000			
4604	From belt No. 4	June 20	1,400,000	250,000	100,000	300,000			
4605	From belt No. 3	June 22	3,400,000	2,000,000	1,000	100,000			

4614	From belt No. 4	June 25	880,000	210,000	1,000		.0015	.0016	7.18
4618	From belt No. 5	June 27	12,000,000	8,400,000	10,000	200,000	.0017	.0019	8.94
4623	....do....	....do....	7,500,000	7,500,000	1,000	40,000	.0018	.0019	6.44
4593		June 24	3,400,000	1,100,000	100,000	100,000	.0013	.0014	8.64
	Visit No. 5.								
4722		July 13	20,000,000	14,000,000	1,000,000		.0008	.0009	10.30
4728	From belt No. 5	July 12	9,400,000	7,000,000	100,000				
4731		July 13	4,100,000	2,300,000	1,000,000		.0010	.0011	8.06
4742	From 4 belts	July 15	9,300,000	4,200,000	1,000,000				11.30
4749	....do....	July 16	4,400,000	3,000,000	10,000		.0015	.0016	8.84
4750	From 5 belts	....do....	2,200,000	700,000	100,000		.0016	.0018	8.86
4788	....do....	July 19					.0016	.0017	8.36
	Visit No. 6.								
4925	From belt No. 5	Aug. 6	5,000,000	2,800,000	1,000,000		.0010	.0011	9.15
4929	From bin	Aug. 7	3,900,000	3,400,000	100,000		.0006	.0006	6.75
4933		Aug. 8	2,300,000	1,900,000	100,000		.0006	.0006	7.43
	Visit No. 7.								
41063	From belt No. 5	Aug. 26	5,800,000	2,100,000	100,000				8.80
41065		Aug. 27	1,100,000	600,000	100,000		.0015	.0016	8.78
41073	From belt No. 5	Aug. 28	12,000,000	2,100,000	10,000		.0017	.0019	10.06
41083	From belt No. 3	Aug. 29	4,200,000	3,100,000	10,000		.0015	.0016	8.82
41084		....do....	5,700,000	2,500,000	100,000		.0014	.0015	8.10
41085	From belt No. 5	....do....	4,800,000	2,300,000	10,000		.0008	.0009	9.84

TABLE E–IV.—*Commercial samples of liquid whole egg from storage tanks, 1912.*

Sample No.	Date of collection of sample.	Date of examination of sample.	Bacteria per gram at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.	Ammonical nitrogen (Folin method).		Moisture.
			20° C.	37° C.			Wet basis.	Dry basis.	
	Third week in April (visit No. 1).						*Per cent.*	*Per cent.*	*Per cent.*
4169	Apr. 22	May 2	700,000	145,000	1,000				
4186	Apr. 25	May 1	900,000	90,000	0	0 in 10,000			
	Average		800,000	120,000					
	Second week in May (visit No. 2).								
4300	May 13	May 15	1,500,000	700,000	100,000	450,000	.0016	.0054	70.29
4350	May 17	May 22	1,000,000	120,000	10,000	150,000	.0016	.0058	72.64
	Average		1,300,000	410,000			.0016	.0056	
	First week in June (visit No. 3).								
[1] 4438	June 1	June 5	2,900,000	1,000,000	100,000	280,000	.0018	.0065	72.29
4463	June 3 (a. m.)	June 7	3,100,000	1,000,000	100,000	50,000	.0016	.0058	72.56
[2] 4464	June 3 (p. m.)	do	4,100,000	2,600,000	100,000	250,000			
4470	June 4 (a. m.)	do	3,200,000	1,200,000		310,000	.0017	.0061	72.09
[3] 4478	June 4 (p. m.)	June 11	2,300,000	1,200,000	10,000		.0019	.0070	72.73
	Average		3,100,000	1,400,000			.0018	.0064	
	Fourth week in June (visit No. 4).								
4589	June 24 (a. m.)	June 26	3,300,000	830,000	100,000	100,000	.0019	.0064	70.23
[4] 4599	June 24 (p. m.)	June 27	4,300,000	800,000	10,000		.0019	.0069	72.43
4607	June 25 (a. m.)	do	2,500,000	570,000	1,000	1,000,000	.0022	.0079	72.23
4612	June 25 (p. m.)	do	2,700,000	1,900,000	0				
4622	June 27	June 28	3,400,000	660,000	10,000	100,000	.0020	.0074	72.90
4636	June 28 (p. m.)	June 29	2,800,000	900,000	100,000	100,000	.0022	.0080	72.64
	Average		3,200,000	940,000			.0020	.0073	
	Second week in July (visit No. 5)—Regular breaking stock.								
4721	July 13 (a. m.)	July 16	4,600,000	2,400,000	1,000,000		.0022	.0079	72.08
4736	July 13 (p. m.)	do	5,500,000	1,700,000	10,000		.0024	.0087	72.48
[5] 4739	July 15 (a. m.)	July 17	4,000,000	1,800,000	100,000		.0021	.0081	74.17
	Average		4,700,000	2,000,000			.0022	.0082	

	Second week in July (visit No. 5)—Current receipts.								
[6] 4762	July 16 (p. m.)	July 18	1,400,000	800,000	100,000		.0022	.0079	72.32
[7] 4767	July 17 (a. m.)	July 19	1,900,000	650,000	100,000		.0020	.0073	72.54
4774	July 17 (p. m.)	...do	1,500,000	550,000	100,000		.0024	.0084	71.55
[6] 4787	July 19	July 22					.0024	.0086	72.18
	Average		1,600,000	680,000			.0023	.0081	
	First week in August (visit No. 6).								
[8] 4906	Aug. 5 (a. m.)	Aug. 7	5,200,000	3,600,000	100,000				72.04
[2]4913	Aug. 5 (p. m.)	...do	3,500,000	3,900,000	100,000		.0021	.0076	72.29
4914	Aug. 6 (p. m.; held in tank 7 hours)	...do	4,500,000	4,200,000	100,000				
[2] 4923	Aug. 6 (p. m.)	Aug. 8	3,200,000	2,500,000	100,000		.0020	.0073	72.49
[9] 4927	Aug. 7 (a. m.)	Aug. 9	4,100,000	3,300,000	100,000		.0020	.0079	72.35
[2] 4932	Aug. 7	...do	5,100,000	5,000,000	1,000,000				
	Average		4,300,000	3,800,000			.0020	.0078	72.29
	Second and third weeks in August (visit No. 7).								
[2] 4939	Aug. 8 (p. m.)[10]		5,400,000	3,500,000	100,000		.0023	.0084	72.57
4049	Aug. 9 (p. m.)		4,600,000	5,000,000	100,000		.0021	.0077	72.58
4050	Aug. 11 (p. m.)		4,300,000	2,300,000	100,000		.0022	.0080	72.34
4051	Aug. 12 (p. m.)		2,600,000	1,200,000	10,000		.0020	.0073	72.60
4052	Aug. 13 (p. m.)		6,400,000	2,700,000	1,000,000		.0024	.0086	72.03
4053	Aug. 14 (p. m.)		5,800,000	3,000,000	1,000,000		.0024	.0084	72.63
4054	Aug. 15 (p. m.)		5,200,000	3,000,000	100,000		.0020	.0071	71.77
4055	Aug. 16 (p. m.)		7,000,000	3,000,000	100,000		.0020	.0072	72.25
4056	Aug. 17 (p. m.)		3,400,000	1,500,000	100,000		.0022	.0080	72.40
4057	Aug. 19 (p. m.)		11,000,000	5,400,000	100,000		.0023	.0085	73.00
4058	Aug. 20 (p. m.)		7,400,000	2,300,000	10,000		.0021	.0078	73.09
	Average		5,700,000	2,900,000	247,000		.0022	.0079	72.48

[1] Temperature of sample, 46° F.
[2] Temperature of sample, 40° F.
[3] Temperature of sample, 42° F.
[4] Temperature of sample, 56° F.
[5] Temperature of sample, 48° F.
[6] Temperature of sample, 38° F.
[7] Temperature of sample, 44° F.
[8] Temperature of sample, 34° F.
[9] Temperature of sample, 35° F.
[10] The sample taken Aug. 8 was collected during the sixth visit. Samples taken between this date and Aug. 19, the first day of the seventh visit, were collected by an employee of E house, and are included with the analyses of samples taken during the seventh visit.

TABLE E–V.—*Comparative commercial samples of egg before and after desiccation, 1912.*

Sample No.	Description of sample.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.	Ammoniacal nitrogen (Folin method).		Moisture.
			20° C.	37° C.			Wet basis.	Dry basis.	
	Visit No. 1.						*Per cent.*	*Per cent.*	*Per cent.*
4171	Liquid egg from tank No. 3	Apr. 22	290,000	120,000	1,000	400,000			
4177	Dry egg from belt No. 3	do	800,000	1,300,000	1,000	40,000	0.0002	0.0002	9.04
4189	Liquid egg from tank No. 5	Apr. 25	850,000	42,500	10,000	0 in 10,000			
4191	Dry egg from belt No. 5	do	430,000	91,000		110,000	.0006	.0007	7.13
	Visit No. 2.								
4301	Liquid egg	May 13	1,400,000	1,000,000	10,000	400,000			
4312	Dry egg	do	1,400,000	1,100,000	1,000,000	200,000	.0006	.0007	7.78
4351	Liquid egg from tank No. 5	May 17	1,000,000	220,000	100,000	140,000			
4358	Dry egg from belt No. 5	do	13,000,000	11,000,000	100,000	3,700,000	.0010	.0011	9.10
4352	Liquid egg from tank No. 4	do	900,000	310,000	1,000,000	160,000			
4359	Dry egg from belt No. 4	do	3,400,000	2,600,000	100,000	2,700,000	.0012	.0013	9.62
	Visit No. 3.								
4439	Liquid egg from tank No. 1	June 1	3,800,000	1,300,000	100,000	330,000			
4447	Dry egg from belt No. 1	do	4,200,000	1,600,000	100,000	100,000			
4440	Liquid egg from tank No. 2	do	3,100,000	1,200,000	100,000	350,000			
4449	Dry egg from belt No. 2	do	1,600,000	600,000	100,000	100,000			
4441	Liquid egg from tank No. 3	do	3,300,000	1,700,000	100,000	220,000			
4451	Dry egg from belt No. 3	do	4,200,000	1,700,000	100,000	200,000	.0008	.0009	9.89
4443	Liquid egg from tank No. 4	do	3,100,000	1,300,000	1,000,000	310,000			
4453	Dry egg from belt No. 4	do	1,300,000	750,000	100,000	150,000	.0008	.0009	9.07
4445	Liquid egg from tank No. 5	do	4,000,000	1,400,000	100,000	280,000			
4455	Dry egg from belt No. 5	do	1,200,000	900,000	100,000	120,000			
	Visit No. 4.								
4592	Liquid egg from tank No. 5	June 24	4,000,000	850,000	100,000	1,000,000	.0020	.0073	72.66
4593	Dry egg from belt No. 5	do	3,400,000	1,100,000	100,000	100,000	.0013	.0014	8.64

	Visit No. 5.									
4740	Liquid egg from all 5 tanks	July 15	7,400,000	5,300,000	100,000					
4742	Dry egg from all 5 belts	do	9,300,000	4,200,000	1,000,000					11.30
	Visit No. 6.									
4922	Liquid egg from tank No. 5	Aug. 6	5,100,000	3,400,000	100,000		.0020	.0073	72.55	
4925	Dry egg from belt No. 5	do	5,000,000	2,800,000	1,000,000		.0010	.0011	9.15	
	Visit No. 7.									
41061	Liquid egg from tank No. 5	Aug. 26	19,000,000	5,500,000	100,000		.0031	.0112	72.38	
41063	Dry egg from belt No. 5	do	5,800,000	2,100,000	100,000				8.80	
41072	Liquid egg from tank No. 5	Aug. 28	6,400,000	2,200,000	100,000				72.67	
41073	Dry egg from belt No. 5	do	12,000,000	2,100,000	10,000		.0017	.0019	10.06	
41078	Liquid egg from tank No. 3	Aug. 29	8,200,000	2,900,000	1,000,000		.0025	.0089	71.98	
41083	Dry egg from belt No. 3	do	4,200,000	3,100,000	10,000		.0015	.0016	8.82	
41079	Liquid egg from tank No. 4	do	11,000,000	3,100,000	100,000		.0026	.0093	72.00	
41084	Dry egg from belt No. 4	do	5,700,000	2,500,000	100,000		.0014	.0015	8.10	
41080	Liquid egg from tank No. 5	do	8,400,000	3,500,000	100,000		.0026	.0093	72.07	
41085	Dry egg from belt No. 5	do	4,800,000	2,300,000	10,000		.0008	.0009	9.84	

TABLE E–VI.—*Commercial samples of whites and yolks—Trough method of separation, 1912.*

Sample No.	Description and size of sample.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Ammoniacal nitrogen (Folin method).		Moisture.
			20° C.	37° C.		Wet basis.	Dry basis.	
	Visit No. 4.					*Per cent.*	*Per cent.*	*Per cent.*
4608	Whites, 24 dozen	June 25	1,000	0 in 1,000	0	0.0006	0.0049	87.68
4609	Yolks of No. 4608, 24 dozen	..do....	5,500	500	0	.0029	.0072	59.56
4626	Whites, 10 pounds	June 27	750,000	1,000	0	.....	.....	.....
4627	Yolks of No. 4626, 15 pounds	...do....	1,300,000	1,000	0	.....	.....	.....
	Visit No. 5.							
4723	Whites, 90 pounds	July 13	1,800,000	600,000	10,000	.0005	.0040	87.55
4747	Whites, 20 pounds	July 16	1,000,000	850,000	100,000	.....	.....	.....
4748	Yolks of No. 4747, 20 pounds	...do....	1,100,000	1,300,000	10,000	.....	.....	.....
4771	Whites, 19 pounds	July 17	34,000	13,000	1,000	.....	.....	.....
4772	Yolks, 19 pounds	...do....	30,000	18,500	1,000	.0039	.0092	57.72
	Visit No. 6.							
4920	Whites, 270 pounds	Aug. 6	300,000	330,000	10,000	.0005	.0043	88.31
4921	Yolks of No. 4920, 270 pounds	...do....	900,000	700,000	10,000	.0034	.0081	58.02
4937	Whites, 150 pounds	Aug. 8	1,200,000	600,000	10,000	.....	.....	.....
4938	Yolks of No. 4937, 150 pounds	...do....	430,000	250,000	10,000	.0036	.0086	58.16

TABLE E-VII.—*Commercial samples of leaking eggs—Handled by the tray method, 1912.*

Sample No.	Size of sample.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.	Ammoniacal nitrogen (Folin method).		Moisture.	Number of eggs discarded.
			20° C.	37° C.			Wet basis.	Dry basis.		
	Visit No. 4.						*Per cent.*	*Per cent.*	*Per cent.*	
4591	6 dozen	June 24	1,300,000	550,000	10	140,000	0.0022	0.0073	69.78	2
4595	5 dozen	...do...	2,700,000	900,000	100	50,000				3
4606	5 dozen	June 25	410,000	4,200	0		.0023	.0076	69.68	1
4613	5 dozen	...do...	3,500,000	480,000	10,000					1
4625	5 dozen	...do...	1,800,000	1,200,000	1,000	10,000				7
4628	5 dozen	June 28	200,000	44,500	10,000		.0020	.0068	70.60	3
	Visit No. 5.									
4730	18 dozen	July 13	3,500,000	2,000,000	1,000		.0023	.0073	68.63	
4741	25 pounds	July 15	6,000,000	5,100,000	100,000					
4744	30 dozen	...do...	800,000	500,000	100,000					
4745	24 dozen	...do...	4,300,000	3,400,000	10,000					[1] 3
4756	24 pounds	July 16	2,300,000	550,000	10,000		.0024	.0078	69.21	[1] 3
4763	30 dozen	...do...	5,600,000	650,000	100,000		.0022	.0066	66.86	[1] 5
4764	18 dozen	July 17	500,000	59,000	100		.0023	.0074	68.86	[1] 3.2
4770	30 dozen	...do...	3,200,000	650,000	1,000		.0028	.0079	64.53	35
4779	30 dozen	July 19					.0024	.0078	69.05	36
	Visit No. 6.									
4924	30 dozen	Aug. 6	5,400,000	5,900,000	10,000		.0025	.0070	64.12	[1] 4½
4943	25 pounds, pail three-fourths full	Aug. 8	2,500,000	1,000,000	1,000		.0024	.0076	68.42	

[1] Pounds.

TABLE E-VIII.—*Summary of bacteriological results on commercial samples of liquid and dried eggs, 1912.*

NUMBER OF ORGANISMS PER GRAM.

Description of sample.	50,001 to 100,000		100,001 to 500,000		500,001 to 1,000,000		1,000,001 to 5,000,000		5,000,001 to 10,000,000		10,000,001 and over.		Total number of samples
	No.[1]	Per cent.	No.[1]	Per cent.	No.[1]	Per cent.	No.[1]	Per cent.	No.[1]	Per cent.	No.[1]	Per cent.	
I.													
Samples taken during three different stages of the preparation of desiccated eggs:													
Liquid egg from storage tanks (Table E-IV)					2	5.26	26	68.42	9	23.67	1	2.63	38
Liquid egg from supply tanks to drying belts (Table E-V)			1	5.55	3	16.66	7	38.88	5	27.77	2	11.11	18
Flaky dried egg directly from drying belts (Table E-III)	1	2.08	1	2.08	6	12.50	30	62.50	7	14.58	3	6.25	48
Wet lumps directly from drying belts (Table E-II)							13	50.00	7	26.92	6	23.07	26
II.													
Comparative samples of whole egg before and after desiccation:													
Liquid egg from supply tank to belt (Table E-V)			1	5.55	3	16.66	7	38.88	5	27.77	2	11.11	18
Flaky dried egg directly from drying belt (Table E-V)			1	5.55			12	66.66	3	16.66	2	11.11	18
III.													
Comparative samples of flaky dried egg and wet lumps:													
Flaky dried egg directly from drying belt (Table E-III)			1	5.00	2	10.00	14	70.00	2	10.00	1	5.00	20
Wet lumps directly from drying belt (Table E-II)							10	50.00	5	25.00	5	25.00	20
Total													206

NUMBER OF GAS-PRODUCING ORGANISMS PER GRAM IN LACTOSE BILE.

Description of sample.	0		1,000		10,000		100,000		1,000,000		Total number of samples.
	No.[1]	Per cent.	No.[1]	Per cent.	No.[1]	Per cent.	No.[1]	Per cent.	No.[1]	Per cent.	
IV.											
Samples taken during three different stages of the preparation of desiccated eggs:											
Liquid egg from storage tanks (Table E–IV)	2	5.4	2	5.4	7	18.91	22	59.45	4	10.81	37
Liquid egg from supply tanks to drying belts (Table E–V)			1	5.55	2	11.11	12	66.66	3	16.66	18
Flaky dried egg from drying belts (Table E–III)	1	2.08	11	22.91	13	27.08	17	35.41	6	12.50	48
Wet lumps from drying belts (Table E–II)			1	3.85	4	15.38	11	42.30	10	38.50	26
V.											
Comparative samples of whole egg before and after desiccation:											
Liquid egg from supply tank to belt (Table E–V)			1	5.88	1	5.88	12	70.58	3	17.64	17
Flaky dried egg from belt (Table E–V)			1	5.88	3	17.64	10	58.82	3	17.64	17
VI.											
Comparative samples of flaky dried egg and wet lumps:											
Flaky dried egg directly from belt (Table E–III)			2	10.52	5	26.31	8	42.10	4	21.05	19
Wet lumps directly from belt (Table E–II)					3	15.79	8	42.10	8	42.10	19
Total											201

[1] Number of samples.

TABLE F–I.—*Successive commercial samples of mixed egg, 1912.*

Sample No.	Description of sample (broken from cracked eggs).	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.	Ammoniacal nitrogen (Folin method).		Moisture.
			20° C.	37° C.			Wet basis.	Dry basis.	
	Visit No. 1.						*Per cent.*	*Per cent.*	*Per cent.*
4207	Liquid egg from buckets	May 1	1,000,000	750,000	10,000	280,000			
4208	Liquid egg from churn	...do...	800,000	500,000	100,000	240,000	0.0017	0.0053	68.89
4209	Liquid egg from three creamery cans	...do...	950,000	700,000	10,000	200,000			
4210	Liquid egg from hose	...do...	1,100,000	800,000	100,000	130,000			
4211	Liquid egg from feeding trough	...do...	850,000	410,000	10,000	360,000			
4212	Dried egg from belt	...do...	650,000	600,000	10,000	130,000	.0008	.0010	11.25
4213	Dried egg after second drying	...do...	800,000	440,000	10,000	80,000	.0007	.0007	3.74
4225	Liquid egg from churn	May 3	1,000,000	370,000	100,000	110,000	.0017	.0057	70.81
4226	Liquid egg from creamery cans	...do...	1,100,000	480,000	100,000	150,000			
4227	Liquid egg from supply tank	...do...	900,000	350,000	1,000	250,000			
4228	Liquid egg from hose	...do...	900,000	290,000	10,000	190,000			
4229	Liquid egg from feeding trough	...do...	1,300,000	600,000	10,000	110,000			
4230	Dried egg from belt	...do...	1,000,000	340,000	100,000	190,000	.0012	.0014	12.46
4231	Dried egg after second drying	...do...	850,000	480,000	1,000	160,000	.0012	.0013	4.89
	Visit No. 2.								
4379	Liquid egg from hose	May 23	6,800,000	1,300,000	100,000	2,000,000	.0024	.0073	67.22
4380	Dried egg from belt	...do...	10,000,000	10,000,000	100,000	80,000	.0013	.0015	11.03
4381	Dried egg after second drying	...do...	21,000,000	20,000,000	100,000	38,000			9.21
	Visit No. 4.								
4651	Liquid egg from supply tank	July 1	3,700,000	2,200,000	100,000	200,000	.0026	.0080	67.50
4652	Dried egg from belt	...do...	4,000,000	2,300,000	100,000	500,000	.0024	.0027	9.92
4653	Dried egg after second drying	...do...	14,000,000	14,000,000	100,000	10,000			4.65
4661	Liquid egg from supply tank	July 2	1,100,000	330,000	10,000	0 in 100,000	.0024	.0075	68.14
4662	Dried egg from belt	...do...	36,000,000	29,000,000	10,000	0 in 10,000	.0021	.0024	10.99
4663	Dried egg after second drying	...do...	22,000,000	22,000,000	10,000	0 in 10,000			
4664	Wet lumps	...do...	60,000,000	62,000,000	10,000				
4665	Liquid egg from supply tank	...do...	1,200,000	230,000	1,000	0 in 10,000	.0027	.0082	67.00
4666	Dried egg from belt	...do...	50,000,000	51,000,000	10,000	250,000	.0031	.0035	11.85
4667	Dried egg after second drying	...do...	35,000,000	28,000,000	100,000	0 in 100,000			

TABLE F–II.—*Commercial samples of dried yolk before and after secondary drying, 1912.*

BEFORE SECONDARY DRYING.

Sample No.	No. of visit.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.	Ammoniacal nitrogen (Folin method).		Moisture.
			20° C.	37° C.			Wet basis.	Dry basis.	
							Per cent.	*Per cent.*	*Per cent.*
4232 [1]	1	May 3	71,000	28,500	100	0 in 100,000	0.0017	0.0018	9.02
4248	1	May 4	17,000,000	18,000,000	10,000	100,000	.....	.....	.....
4372	2	May 6	130,000	51,000	10,000	12,000	.....	.....	.....
4515 [2]	3	June 11	110,000,000	160,000,000	100,000	0 in 10,000	.0083	.0096	13.40
4644	4	June 22	80,000,000	89,000,000	1,000	0 in 100,000	.....	.....	.....

AFTER SECONDARY DRYING.

4483	3	May 29	1,800,000	2,000,000	10,000	25,000	.....	.....	.....
4492	3	June 10	77,000,000	78,000,000	100,000	8,000	.0056	.0059	5.07
4493	3	...do....	49,000,000	44,000,000	100,000	10,000	.0052	.0055	6.25
4518 [3]	3	June 12	95,000,000	68,000,000	10,000	0 in 10,000	.....	.....	3.88
4641	4	June 17	3,200,000	3,000,000	100,000	0 in 10,000	.....	.....	.....
4643	4	June 19	33,000,000	36,000,000	100,000	0 in 100,000	.....	.....	.....
4645	4	June 24	2,100,000	1,900,000	100,000	0 in 100,000	.....	.....	.....
4646	4	June 26	39,000,000	33,000,000	10,000	0 in 100,000	.....	.....	.....
4648	4	June 27	86,000,000	60,000,000	100,000	200,000	.....	.....	.....
4997 [4]	6	Aug. 16	29,000,000	24,000,000	1,000	.....	.0052	.0055	4.96

[1] Previous run to Nos. 4225 to 4231. [2] Same egg as No. 4518. [3] Same egg as No. 4515. [4] Dried yolk.

TABLE F–III.—*Commercial samples of mixed egg, 1912.*

Sample No.	Description of sample.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.	Ammoniacal nitrogen (Folin method).		Moisture.
			20° C.	37° C.			Wet basis.	Dry basis.	
	Visit No. 1.						*Per cent.*	*Per cent.*	*Per cent.*
4208	Cracked eggs from churn	May 1	800,000	500,000	100,000	240,000	0.0017	0.0053	68.89
4225	....do	May 3	1,000,000	370,000	100,000	110,000	.0017	.0057	70.81
	Visit No. 2.								
4379	From hose of supply tank	May 23	6,800,000	1,300,000	100,000	2,000,000	.0024	.0073	67.22
4385	Mostly seconds from churn	...do	470,000	220,000	100,000	60,000	.0019	.0060	68.23
	Visit No. 3.								
4502	Mostly seconds from churn	June 11	1,000,000	420,000	10,000	300,000	.....	.....	.....
	Visit No. 4.								
4651	From supply tank	July 1	3,700,000	2,200,000	100,000	200,000	.0026	.0080	67.50
4661	....do	July 2	1,100,000	330,000	10,000	0 in 100,000	.0024	.0075	68.14
4671	From churn	...do	700,000	400,000	100,000	0 in 100,000	.0022	.0069	67.96
4665	From supply tank	...do	1,200,000	230,000	1,000	0 in 10,000	.0027	.0082	67.00
4654	....do	July 1	1,300,000	650,000	100,000	100,000	.....	.....	.....
4673	From churn	July 3	1,400,000	410,000	10,000	0 in 100,000	.0026	.0079	67.29
4674	....do	...do	1,300,000	450,000	10,000	0 in 100,000	.0025	.0077	67.58

TABLE F–IV.—*Commercial samples of mixed egg before and after secondary drying, 1912.*

Sample No.	Number of visit.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.	Ammoniacal nitrogen (Folin method).		Moisture.
			20° C.	37° C.			Wet basis.	Dry basis.	
SAMPLES TAKEN FROM BELT.									
							Per cent.	*Per cent.*	*Per cent.*
4212	1	May 1	650,000	600,000	10,000	130,000	0.0008	0.0010	11.25
4230	1	May 3	1,000,000	340,000	100,000	190,000	.0012	.0014	12.46
4373	2	May 9	430,000	100,000	1,000	15,000	.....	.....	.....
4374	2	May 10	800,000	700,000	10,000	16,000	.....	.....	.....
4375	2	May 13	160,000	85,000	10,000	40,000	.....	.....	.....
4376	2	May 15	3,100,000	2,900,000	1,000	25,000	.....	.....	.....
4377	2	May 17	320,000	150,000	1,000	35,000	.....	.....	.....
4380	2	May 23	10,000,000	10,000,000	100,000	80,000	.0013	.0015	11.03
4482	3	May 27	1,300,000	1,400,000	1,000,000	0 in 100	.....	.....	.....
4491	3	June 10	3,200,000	3,400,000	100,000	100,000	.0008	.0009	11.60
4516	3	June 11	53,000,000	58,000,000	100,000	400,000	.0021	.0024	10.84
4642	4	June 18	200,000,000	190,000,000	100,000	100,000	.....	.....	.....
4652	4	July 1	4,000,000	2,300,000	100,000	500,000	.0024	.0027	9.92
4662	4	July 2	36,000,000	29,000,000	10,000	0 in 10,000	.0021	.0024	10.99
4666	4	...do.....	50,000,000	51,000,000	10,000	250,000	.0031	.0035	11.85
SAMPLES TAKEN AFTER SECONDARY DRYING.									
4213	1	May 1	800,000	440,000	10,000	80,000	0.0007	0.0007	3.74
4231	1	May 3	850,000	480,000	1,000	160,000	.0012	.0013	4.89
4381	2	May 23	21,000,000	20,000,000	100,000	38,000	.....	.....	9.21
4484	3	May 31	7,400,000	5,900,000	1,000,000	10,000	.....	.....	.....
4485	3	June 3	4,400,000	5,200,000	10,000	12,000	.....	.....	.....
4486	3	June 5	42,000,000	45,000,000	10,000	8,000	.....	.....	.....
4487	3	June 7	5,400,000	3,000,000	1,000,000	20,000	.....	.....	.....
4494	3	June 10	59,000,000	59,000,000	1,000,000	22,000	.0003	.0003	8.20
4519	3	June 12	39,000,000	34,000,000	1,000,000	200,000	.....	.....	5.26
4647	4	June 25	86,000,000	77,000,000	1,000,000	300,000	.....	.....	.....
4649	4	June 28	23,000,000	21,000,000	100,000	1,000,000	.....	.....	.....
4650	4	June 29	84,000,000	77,000,000	100,000	100,000	.....	.....	.....
4653	4	July 1	14,000,000	14,000,000	100,000	10,000	.....	.....	4.65
4663	4	July 2	22,000,000	22,000,000	10,000	0 in 10,000	.....	.....	.....
4667	4	...do.....	35,000,000	28,000,000	100,000	0 in 100,000	.....	.....	.....
4680	4	July 3	36,000,000	34,000,000	100,000	1,000,000	.0021	.0023	6.96
4998	6	Aug. 16	70,000,000	38,000,000	10,000	.....	.0022	.....	.....

TABLE F–V.—*Commercial samples of second-grade frozen egg, 1912.*

Sample No.	Size and description of sample.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.	Ammoniacal nitrogen (Folin method).		Moisture.
			20° C.	37° C.			Wet basis.	Dry basis.	
	Visit No. 2.						*Per cent.*	*Per cent.*	*Per cent.*
4365	400 pounds from churn	May 21	58,000,000	21,000,000	1,000,000	+in 100,000	0.0025	0.0111	77.56
4369	3 pounds from can	...do.....	27,000,000	1,900,000	10,000	18,000,000	.0040	.0182	78.07
4383	15 pounds from can	May 23	47,000,000	18,000,000	1,000,000	15,000,000	.0031	.0133	76.69
	Visit No. 3.								
4498	10 pounds from bucket	June 10	4,200,000	2,400,000	100,000	50,000	.0014	.0068	79.35
4501	25 pounds (seconds) from bucket	June 11	22,000,000	12,000,000	1,000,000	6,500,000	.0022	.0079	72.27
4512	10 pounds (seconds) from bucket	...do.....	59,000,000	38,000,000	1,000,000	5,500,000	.0026	.0130	80.02
4527	400 pounds from churn	June 12	11,000,000	8,600,000	1,000,000	1,400,000	.....	.....	.....
	Visit No. 4.								
4659	From bucket	July 2	6,800,000	10,000,000	100,000	5,000,000	.0008	.0052	84.60
4675	400 pounds from churn	July 3	33,000,000	17,000,000	10,000,000	10,000,000	.0025	.0124	79.86
	Visit No. 5.								
4796	3 pounds from bucket	July 22	7,300,000	5,500,000	10,000	.....	.0026	.0097	73.20
4800	400 pounds from churn	...do.....	.....	.....	10,000	.....	.0023	.0110	79.06
4809	10 pounds from bucket	...do.....	92,000,000	72,000,000	10,000	.....	.0021	.0111	81.02
4826	90 pounds from churn	July 23	11,000,000,	11,000,000	100,000	.....	.0019	.0099	80.81
	Visit No. 6.								
4954	15 pounds from bucket	Aug. 12	84,000,000	79,000,000	100,000	.....	.0022	.0078	71.79
4970	400 pounds from churn	Aug. 13	32,000,000	31,000,000	1,000,000	.....	.0028	.0144	80.60

TABLE F–VI.—*Commercial samples of mixed egg before and after drying on belt, 1912.*

Sample No.	Description of sample.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.	Ammoniacal nitrogen (Folin method).		Moisture.
			20° C.	37° C.			Wet basis.	Dry basis.	
	Visit No. 1.						*Per cent.*	*Per cent.*	*Per cent.*
4208	Liquid egg	May 1	800,000	500,000	100,000	240,000	0.0017	0.0053	68.89
4212	Dried egg	...do.....	600,000	600,000	10,000	130,000	.0008	.0010	11.25
4225	Liquid egg	May 3	1,000,000	370,000	100,000	110,000	.0017	.0057	70.81
4230	Dried egg	...do.....	1,000,000	340,000	100,000	190,000	.0012	.0014	12.46
	Visit No. 2.								
4379	Liquid egg	May 23	6,800,000	1,300,000	100,000	2,000,000	.0024	.0073	67.22
4380	Dried egg	...do.....	10,000,000	10,000,000	100,000	80,000	.0013	.0015	11.03
	Visit No. 4.								
4651	Liquid egg	July 1	3,700,000	2,200,000	100,000	200,000	.0026	.0080	67.50
4652	Dried egg	...do.....	4,000,000	2,300,000	100,000	500,000	.0024	.0027	9.92
4661	Liquid egg	July 2	1,100,000	330,000	10,000	0 in 100,000	.0024	.0075	68.14
4662	Dried egg	...do.....	36,000,000	29,000,000	10,000	0 in 10,000	.0021	.0024	10.99
4665	Liquid egg	...do.....	1,200,000	230,000	1,000	0 in 10,000	.0027	.0082	67.00
4666	Dried egg	...do.....	50,000,000	51,000,000	10,000	250,000	.0031	.0035	11.85

TABLE F-VII.—*Commercial samples of yolks from churn, mechanical method of separation, 1912.*

Sample No.	Description and size of sample.	Date of collection.	Bacteria per gram on plain agar incubated at—		Number of gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.	Ammoniacal nitrogen (Folin method).		Moisture.
			20° C.	37° C.			Wet basis.	Dry basis.	
	WITHOUT ADDED SUGAR.								
	Visit No. 1:						*Per cent.*	*Per cent.*	*Per cent.*
4246	Seconds and cracked eggs, 400 pounds	May 4	160,000	76,000	1,000	30,000			
	Visit No. 3:								
4506	Seconds and cracked eggs, 400 pounds	June 11	370,000	170,000	1,000	50,000			
4513	Seconds, 400 pounds	...do...	210,000	200,000	1,000	40,000			
	Visit No. 5:								
4830	Cracked eggs, 400 pounds	July 24	1,800,000	1,600,000	10,000				
	WITH 10 PER CENT ADDED SUGAR.								
	Visit No. 4:								
4676	400 pounds	July 13	290,000	210,000	100,000	1,000,000			
	Visit No. 5:								
4797	Firsts, seconds, and cracked eggs, 200 pounds	July 22	550,000	390,000	10,000		0.0031	0.0063	50.41
4804	400 pounds	...do...	500,000	350,000	0		.0033	.0067	50.38
4811	Do	...do...	200,000	160,000	10,000				
4821	Firsts, 400 pounds	July 23	150,000	130,000	10,000		.0029	.0058	50.30
4822	Do	...do...	34,000	41,000	1,000		.0029	.0058	49.89
4825	Firsts and seconds, 400 pounds	...do...	70,000	64,000	1,000				
4828	Cracked eggs, 400 pounds	July 24	2,400,000	2,100,000	100,000		.0029	.0060	51.74
4832	Firsts and cracked eggs, 400 pounds	...do...	1,000,000	700,000	100,000				
4839	Firsts and cracked eggs	July 25	420,000	480,000	10,000				
	Visit No. 6:								
4959	Firsts, 400 pounds	Aug. 12	480,000	440,000	10,000		.0031	.0065	52.06
4969	Firsts and seconds, 400 pounds	Aug. 13	460,000	340,000	1,000				
4973	Firsts, seconds, and cracked eggs, 400 pounds	Aug. 14	350,000	350,000	10,000		.0028	.0060	53.07
4968	Firsts and seconds, 400 pounds	Aug. 13	7,500,000	440,000	10,000				

TABLE F–VIII.—*Commercial samples of soft egg, 1912.*

Sample No.	Description and size of sample.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.	Ammoniacal nitrogen (Folin method).		Moisture.
			20° C.	37° C.			Wet basis.	Dry basis.	
							Per cent.	*Per cent.*	*Per cent.*
4368	*Visit No. 2.*	May 21	35,000,000	10,000,000	100	2,500,000	0.0024	0.0084	71.54
	Visit No. 3.								
4497	From bucket, 3 pounds	June 10	390,000	320,000	100,000	14,000	.0020	.0071	71.91
4511	From bucket, 30 pounds	June 11	14,000,000	4,300,000	10,000	.....	.0029	.0098	70.49
4523	From bucket, 15 pounds	June 12	5,900,000	6,100,000	1,000,000	330,000	.0021	.0070	69.94
4531	From bucket	June 13	250,000	190,000	10,000	10,000	.....	.....	.....
	Visit No. 4.								
4658	From bucket	July 2	130,000	13,000	1,000	190,000	.0021	.0075	71.95
	Visit No. 5.								
4795	From bucket, 22 pounds	July 22	3,600,000	3,000,000	1,000	.....	.0025	.0083	70.02
4798	From churn	do	11,000,000	55,000,000	100,000	.....	.0023	.0085	72.99
4808	From bucket, 25 pounds	do	[1]	63,000,000	10,000	.....	.0031	.0094	67.04
4810	From churn, 200 pounds	do	80,000,000	76,000,000	1,000,000	.....	.....	.....	.....
4819	Firsts from churn, 200 pounds	July 23	950,000	850,000	100,000	.....	.0018	.0066	72.76
4834	Firsts, seconds, and cracked, 400 pounds eggs from churn	July 24	4,900,000	3,000,000	100,000	.....	.0020	.0071	71.96
	Visit No. 6.								
4961	Firsts and seconds from churn, 400 pounds	Aug. 12	2,100,000	2,000,000	100,000	.....	.0021	.0078	72.99

[1] Innumerable in 100,000.

TABLE F–IX.—*Commercial samples of whole egg from churn, 1912.*

Sample No.	Description and size of sample.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Ammoniacal nitrogen (Folin method).		Moisture.
			20° C.	37° C.		Wet basis.	Dry basis.	
	Visit No. 5.					*Per cent.*	*Per cent.*	*Per cent.*
4846	Firsts and seconds, 360 pounds	July 25	1,200,000	850,000	10,000			
	Visit No. 6.							
4956	Firsts and seconds, 400 pounds	Aug. 12	2,300,000	1,500,000	100,000	0.0019	0.0067	71.62
4962	Firsts	...do...	550,000	500,000	10,000	.0020	.0071	71.67
4980	Firsts and seconds, 400 pounds	Aug. 14	500,000	450,000	1,000	.0019	.0071	73.29
4984	Firsts, seconds, and cracked eggs, 400 pounds	Aug. 15	1,900,000	1,300,000	100,000			
4986	Firsts, 400 pounds	...do...	3,500,000	1,800,000	10,000			
4989	.....do.....	...do...	340,000	200,000	10			
4991	.....do.....	...do...	1,000,000	550,000	10,000	.0021	.0070	72.30
4996	Seconds and cracked eggs, 400 pounds	Aug. 16	700,000	460,000	10,000	.0019	.0070	72.80

TABLE F–X.—*Commercial samples of leaking eggs—Handled by the tray method, F house, 1912.*

Sample No.	Size and description of sample.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.	Ammoniacal nitrogen (Folin method).		Moisture.	Eggs discarded.
			20° C.	37° C.			Wet basis.	Dry basis.		
	Visit No. 3.									
	Whole egg:						*Per cent.*	*Per cent.*	*Per cent.*	
4488	6 dozen	June 10	950,000	750,000	1,000	0 in 100,000	0.0017	0.0059	70.92	.....
4490	Do	...do...	110,000	74,000	1,000	250,000	.0015	.0049	71.42	1
4507	Do	June 11	23,500	4,000	10	4,000	.....	.....	.....	0
4508	Do	...do...	49,500	54,000	1,000	25,000	.0019	.0064	70.31	.....
4520	Do	June 12	54,000	40,000	100	0 in 1,000	.0019	.0063	69.68	0
4524	Do	...do...	1,700,000	2,000,000	10,000	4,000	.0020	.0063	68.34	1
4525	Do	...do...	1,400,000	420,000	1,000	25,000	.0017	.0059	71.26	.....
	White and yolk separated:									
4514	6 dozen whites	June 11	52,000	33,000	10	2,000	.0004	.0033	88.08	.....
4517	6 dozen yolks of No. 4514	...do...	250,000	120,000	100	0 in 1,000	.0029	.0062	54.62	.....
	Visit No. 4.									
	Whole egg:									
4655	6 dozen	July 1	430,000	360,000	1,000	60,000	.....	.....	.....	4
4670	Do	July 2	53,000	54,000	0	50,000	.0021	.0067	68.81	3
4681	Do	July 3	77,000	12,000	1,000	10,000	.....	.....	.....	A few.
4682	Do	...do...	1,300,000	1,200,000	1,000,000	20,000	.....	.....	.....	1
	Visit No. 5.									
	Whole egg:									
4792	30 dozen	July 22	900,000	550,000	1,000	.....	.....	.....	.....	26
4820	24 dozen	July 23	2,900,000	2,800,000	10,000	.....	.0027	.0078	65.59	42
	Visit No. 6.									
	Whole egg:									
4958	6 dozen	Aug. 12	.....	4,500,000	10,000	.....	.0025	.0080	68.62	.....
4974	Do	Aug. 14	650,000	700,000	10,000	.....	.0018	.0058	68.76	.....
4979	12 dozen	...do...	240,000	140,000	1,000	.....	.0020	.0065	69.16	.....
4990	15 dozen	Aug. 15	1,100,000	800,000	1,000	.....	.0021	.0068	69.25	10
4995	6 dozen	Aug. 16	1,500,000	1,000,000	100	.....	.0023	.0075	69.17	10

TABLE F-XI.—*Detailed summary of bacteriological results on commercial samples taken before and after drying, 1912.*

TOTAL NUMBER OF ORGANISMS PER GRAM.

Description of samples.	101 to 1,001		1,001 to 10,000		10,001 to 50,000		50,001 to 100,000		100,001 to 500,000		500,001 to 1,000,000		1,000,001 to 5,000,000		5,000,001 to 10,000,000		10,000,001 to 50,000,000		50,000,001 to 100,000,000		100,000,001 to 500,000,000		Total number of samples.
	Number.[1]	Per cent.	Number.[1]	Per cent.	Number.[1]	Per cent.	Number.[1]	Per cent.	Number.[1]	Per cent.	Number.[1]	Per cent.	Number.[1]	Per cent.	Number.[1]	Per cent.	Number.[1]	Per cent.	Number.[1]	Per cent.	Number.[1]	Per cent.	
Liquid egg:																							
White from grading table (Table 21)	1	10.0	.....	.....	3	30.0	.....	.....	3	30.0	1	10.0	1	10.0	1	10.0	.....	.....	.....	.....	.....	.....	10
Yolk from grading table (Table 21)	.....	.....	2	20.0	1	10.0	.....	.....	2	20.0	1	10.0	2	20.0	2	20.0	.....	.....	.....	.....	.....	.....	10
Yolk from mixing churn (Table F-VII)	.....	.....	.....	.....	1	5.55	1	5.55	11	61.11	2	11.11	2	11.11	1	5.55	.....	.....	.....	.....	.....	.....	18
Whole egg (Table F-IX)	.....	.....	.....	.....	.....	.....	.....	.....	2	22.22	3	33.33	4	44.44	.....	.....	.....	.....	.....	.....	.....	.....	9
Mixed egg (Table F-III)	.....	.....	.....	.....	.....	.....	.....	.....	1	8.33	4	33.33	6	50.0	1	8.33	.....	.....	.....	.....	.....	.....	12
Soft egg (Table F-VIII)	.....	.....	.....	.....	.....	.....	.....	.....	3	23.07	1	7.69	3	23.07	1	7.69	2	15.38	3	23.07	.....	.....	13
Second-grade egg (Table F-V)	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	7.14	2	14.28	7	49.98	4	28.57	.....	.....	14
Desiccated egg:																							
Yolks (Table F-II)	.....	.....	.....	.....	.....	.....	1	6.66	1	6.66	.....	.....	3	20.0	.....	.....	5	33.33	4	26.66	1	6.66	15
Mixed egg (Table F-IV)	.....	.....	.....	.....	.....	.....	.....	.....	3	9.38	5	15.62	5	15.62	3	9.38	10	31.24	5	15.62	1	3.12	32
Comparative samples of mixed egg before and after desiccation:																							
Liquid (Table F-VI)	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	33.33	3	50.0	1	16.66	.....	.....	.....	.....	.....	.....	6
Dry (Table F-VI)	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	33.33	1	16.66	1	16.66	2	33.33	.....	.....	.....	.....	6
Total	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	145

NUMBER OF GAS-PRODUCING ORGANISMS PER GRAM IN LACTOSE BILE.

Description of samples.	Less than 10.		10		100		1,000		10,000		100,000		1,000,000		10,000,000		Total number of samples.
	Number.[1]	Per cent.	Number.[1]	Per cent.	Number.[1]	Per cent.	Number.[1]	Per cent.	Number.[1]	Per cent.	Number.[1]	Per cent.	Number.[1]	Per cent.	Number.[1]	Per cent.	
Commercial samples of liquid egg:																	
Whites (Table 21)	1	10.0	3	30.0	4	40.0	2	20.0									10
Yolks (Table 21)	1	10.0	3	30.0	3	30.0	1	10.0	1	10.0	1	10.0					10
Yolks from churn (Table F–VII)	1	5.55					6	33.33	8	44.44	3	16.66					18
Whole egg (Table F–IX)			1	11.1			1	11.1	5	55.55	2	22.22					9
Mixed egg (Table F–III)							1	8.33	4	33.33	7	58.33					12
Soft egg (Table F–VIII)					1	7.69	2	15.38	3	23.07	5	38.45	2	15.38			13
Second-grade egg (Table F–V)									4	26.66	4	26.66	6	40.00	1	6.66	15
Commercial samples of desiccated egg:																	
Yolks (Table F–II)					1	6.66	2	13.33	5	33.33	7	46.66					15
Mixed egg (Table F–IV)							4	12.5	10	31.25	12	37.5	6	18.75			32
Comparative samples of mixed egg before and after desiccation:																	
Liquid (Table F–VI)							1	16.66	1	16.66	4	66.66					6
Dry (Table F–VI)									3	50.00	3	50.00					6
Total																	146

[1] Number of samples.

TABLE F–XII.—*Component parts of second-grade frozen egg.*

Sample No.	Size and description of sample.	Source.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Brown colonies in Aesculin agar.	Liquefying organisms per gram.	Ammoniacal nitrogen (Folin method).		Moisture.
				20° C.	37° C.				Wet basis.	Dry basis.	
	I.										
	Eggs with faintly sour odor:								*Per cent.*	*Per cent.*	*Per cent.*
4427	2 eggs, white and yolk intact	D–2	May 28	430,000,000	430,000,000	10,000,000+	+				
4460	White and yolk intact	E–3	June 1	89,000,000	73,000,000	1,000,000+	+	4,400,000	0.0038	0.0141	73.00
4530	5 eggs, soft yolks	F–3	June 13	380,000,000	440,000,000	10,000	+		.0052	.0194	73.19
4815	5 pounds	F–5	July 23	140,000,000	97,000,000	1,000,000+	+		.0032	.0113	71.57
4816	Do	F–5	...do....	160,000,000	130,000,000	10,000,000+	+		.0030	.0122	75.48
4836	2½ pounds	F–5	...do....	130,000,000	120,000,000	1,000,000+	0		.0046	.0151	69.52
	II.										
	Eggs with light-green whites, odorless:										
	Mixed eggs—										
4817	5 pounds	F–5	July 23	49,000,000	23,000,000	10,000	+		.0027	.0094	71.27
4818	Do	F–5	...do....	61,000,000	55,000,000	100,000	+		.0051	.0181	71.86
4420	7 eggs	D–2	May 28	320,000,000	100,000,000	1,000,000	+	3,000,000	.0040	.0136	70.70
	White and yolk separated—										
4396	7 whites	D–2	May 27	100,000,000	55,000,000	100,000	+	20,000,000	.0007	.0050	86.04
4397	Yolks of No. 4396	D–2	...do....	2,700,000	1,800,000	10,000	+	650,000	.0047	.0104	56.84
4504	4 whites	F–3	June 11	210,000,000	210,000,000	100	0	30,000,000			
4505	Yolks of No. 4504	F–3	...do....	26,000,000	4,700,000	0	0	+ in 100,000			
	III.										
	Cracked eggs with moldy shells:										
4217	8 eggs, odor and taste good	F–1	May 2	1,200,000	1,300,000	10	+	230,000	.0019	.0062	69.31
4241	12 eggs, odor and taste good	F–1	May 3	2,700,000	1,700,000	10	0	15,000	.0013	.0043	68.26
4398	8 eggs, odor good	D–2	May 27	4,000,000	3,100,000	100	+	0 in 1,000	.0019	.0058	67.17
4583	4 eggs, odor good	D–3	June 20	8,600,000	5,400,000	100	+	40,000	.0021	.0070	70.18
4596	Odor good	E–4	June 24	12,000,000	5,900,000	0		0	.0025	.0088	71.76
41022	6 eggs, odor good	D–6	Aug. 20	160,000	140,000	1,000			.0019	.0064	70.23
41036	11 pounds, eggs with moldy shells	D–6	Aug. 21	22,000,000	13,000,000	100,000			.0023	.0078	70.39

	IV.										
	Drippings from breaking knife and tray:										
	From cup under breaking knife—										
4521	From 6 cups	F-3	June 12	47,000	32,500	100	+	0 in 10,000			
4522	From 7 cups	F-3	...do	1,900,000	220,000	1,000	+	0 in 100,000			
4660	From 6 cups	F-4	July 2	10,000	5,000	0 in 100	0	0 in 10,000			
4668	From 7 cups	F-4	July 3	13,000,000	1,100,000	100,000	+				
4679	From 10 cups	F-4	...do	240,000	56,000	10,000	0	23,000			
4799	From several cups	F-5	July 22	2,300,000	2,200,000	100,000	0				
4987	5 pounds, after breaking No. 1 eggs	F-6	Aug. 15	420,000	480,000	10,000			.0005	.0040	87.58
	From breaking tray—										
4429	8 ounces, from 1 tray	D-2	May 28	440,000	350,000	100,000	+	0 in 1,000			
4714	From 5 trays	D-4	July 11	2,400,000	1,400,000	10,000	0				
4866	From 1 tray after breaking dirty eggs	D-5	July 30	2,400,000	2,000,000	100,000					

TABLE D-I.—*Commercial samples of whites, yolks, and mixed egg, shell method of separation, 1911.*

[Discussion, p. 53.]

Sample No.	Description of sample.	Date of collection.	Bacteria per gram on plain agar incubated at —		Gas-producing bacteria per gram.	Liquefying organisms per gram in lactose bile.	Ammoniacal nitrogen (Folin method).		Moisture.	Ether extract.
			20° C.	37° C.			Wet basis.	Dry basis.		
	Whites—Shell method of separation:						*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
228	From 25-pound pail—early morning	July 11	700	700	10	0	0.0005			
233	Do	...do	1,900	1,200	10		.0004			
237	Do	July 12	99,000	270,000	100,000	1,000	.0004			
240	Do	...do	49,000	120,000	10,000	7,000	.0004			
347	Do	July 24	4,800,000	4,100,000	100,000	1,500,000	.0002			
367	Do	July 25	200,000	Sterile at 1,000.	100		.0003			
370	Do	...do	42,000	47,500	1,000		.0004			
379	Do	July 26	200,000	190,000	10,000	65,000	.0007			
382	Do	...do	76,000	59,000	10,000		.0006			
	Yolks—Shell method of separation:									
153	Ready for freezer	June 28	220,000	340,000	10,000	12,000	.0032			
159	From churn	...do	140,000	3,000,000	10,000	20,000				
229	Do	July 11	22,000	13,000	1,000		.0031	0.0074	58.06	23.49
232	Do	...do	100,000	65,000	100,000		.0027	.0074	63.38	18.88
238	Do	July 12	490,000	2,000,000	100,000	50,000	.0031	.0076	59.10	22.69
242	Do	...do	3,600	47,000	10,000	0	.0033	.0080	58.60	23.44
348	Do	July 24	4,300,000	4,300,000	100	80,000	.0031	.0076	59.42	22.71
351	Do	...do	510,000	440,000	10,000	1,000	.0031	.0076	59.12	22.78
368	Do	July 25	130,000	52,000	1,000		.0032	.0075	57.24	24.85
371	Do	...do	1,100,000	840,000	100,000		.0031	.0072	56.68	23.24
380	Do	July 26	500,000	480,000	1,000	130,000	.0032	.0077	58.42	24.21
383	Do	...do	490,000	620,000	100,000	100,000	.0032	.0079	59.61	22.98
509	Do	Aug. 10	2,900,000	2,800,000	10,000	210,000	.0029	.0071	59.01	22.56
513	Do	...do	710,000	520,000	10,000	35,000	.0024	.0061	60.83	21.01
	Mixed egg:									
154	Kept about 2 hours at 65° F. before freezing	June 29	630,000	1,400,000	10,000	6,000	.0020	.0065	69.42	13.82
161	From churn	...do	940,000	1,700,000	10,000	32,000				
227	Do	July 11	130,000	720,000	100,000		.0018			
231	Do	...do	14,400	7,700	10,000		.0021			
236	Do	July 12	600,000	970,000	100,000	79,000	.0019			

241	From churn	...do.....	44,500	740,000	10,000	.....	.0024	.....	.....	.....
349	Do	July 24	2,500,000	2,800,000	100,000	90,000	.0022	.....	.....	.....
352	Do	...do.....	3,100,000	3,200,000	100,000	65,000	.0022	.....	.....	.....
369	Do	July 25	1,700,000	1,200,000	100,000	120,000	.0018	.....	.....	.....
372	Do	...do.....	620,000	600,000	100,000	.....	.0018	.....	.....	.....
381	Do	July 26	1,000,000	1,100,000	100,000	55,000	.0021	.....	.....	.....
384	Do	...do.....	1,500,000	980,000	.....	160,000	.0022	.....	.....	.....
508	Do	Aug. 10	820,000	560,000	100,000	0	.0020	.....	.....	.....
510	Do	...do.....	1,200,000	810,000	10,000	.....	.0020	.....	.....	.....

TABLE D–II.—*Commercial samples of mixed egg from churn, 1912.*

Sample No.	Description and size of sample.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.	Ammoniacal nitrogen (Folin method).		Moisture.
			20° C.	37° C.			Wet basis.	Dry basis.	
	Visit No. 1.						*Per cent.*	*Per cent.*	*Per cent.*
4161	Clean, cracked, and dirty eggs, 125 pounds	Apr. 17	5,100	400	100		0.0014	0.0046	69.28
4265	Cracked eggs and a few small and dirty eggs	May 7	170,000	8,100	1,000	70,000			
	Visit No. 2.								
4418	Seconds mixed with a few dirty and cracked eggs, 200 pounds	May 27	320,000	230,000	1,000	0 in 1,000			
4419	200 pounds	May 28	340,000	220,000	1,000	4,000	.0020	.0066	69.84
4425	do	do	950,000	340,000	10,000	0 in 1,000			
	Visit No. 3.								
4541	Seconds, 125 pounds	May 29	950,000	600,000	100,000	100,000			
4543	Seconds and cracked eggs, 125 pounds	June 1	600,000	380,000	100,000	15,000	.0018	.0063	71.43
4544	do	June 3	2,200,000	1,500,000	100,000	150,000	.0019	.0062	69.26
4545	Seconds, 125 pounds	June 4	1,700,000	1,100,000	1,000,000	300,000	.0019	.0061	69.04
4546	Seconds and cracked eggs, 125 pounds	June 5	650,000	500,000	10,000	120,000	.0017	.0058	70.56
4548	Cracked and dirty eggs, 125 pounds	June 7	170,000	120,000	1,000	0 in 1,000			
4565	Seconds, 125 pounds	June 8	210,000	140,000	100,000	20,000			
4568	Seconds (same lot as No. 4565), 125 pounds	do	390,000	250,000	1,000	0 in 1,000			
4549	Seconds and cracked eggs, 125 pounds	June 10	160,000	120,000	1,000	4,000			
4551	do	June 11	340,000	180,000	10,000	4,000			
4562	do	June 13	700,000	500,000	10,000	30,000			
4550	do	June 15	120,000	70,000	1,000	6,000	.0019	.0062	69.54
4554	do	June 17	800,000	490,000	100,000	120,000	.0018	.0059	69.35
	Visit No. 4.								
4683	Seconds and cracked eggs, 125 pounds	June 22	650,000	550,000	10,000	0 in 10,000	.0022	.0075	70.56
4684	Seconds, 125 pounds	June 25	550,000	480,000	10,000	0 in 10,000	.0021	.0070	70.02
4685	Seconds and cracked eggs, 125 pounds	June 27	260,000	130,000	10,000	0 in 10,000	.0019	.0064	70.22
4686	do	July 1	1,100,000	850,000	100,000	25,000	.0025	.0082	69.42
4687	125 pounds	July 3	150,000	100,000	100	10,000	.0021	.0071	70.22
4695	Seconds, 125 pounds	July 9	550,000	310,000	100		.0021	.0072	70.65
4704		July 10	800,000	650,000	1,000		.0017	.0056	69.41

	Visit No. 5.								
4848	Seconds and cracked eggs, 125 pounds	July 12	650,000	500,000	10,000		.0024	.0077	68.72
4850	do	July 16	550,000	550,000	1,000		.0021	.0078	69.24
4851	do	July 19	1,300,000	1,100,000	10,000		.0023	.0076	69.72
4852	do	July 22	1,100,000	950,000	100,000		.0023	.0073	68.38
4853	do	July 23	330,000	280,000	1,000		.0022	.0071	68.88
4863	Seconds, 125 pounds	July 29	1,900,000	1,300,000	10,000		.0021	.0066	68.33
4864	do	July 30	1,200,000	950,000	100,000		.0022	.0072	69.63
4872	Seconds and a few cracked eggs	do	2,200,000	1,800,000	100,000				
4875	Seconds and cracked eggs, 125 pounds	July 31	3,300,000	2,700,000	100,000		.0019	.0060	68.53
4879	Seconds, cracked, and leaking eggs, 125 pounds	do	1,800,000	2,000,000	100,000		.0020	.0063	68.39
4885	Seconds and a few cracked eggs, 125 pounds	do	650,000	600,000	1,000,000		.0021	.0067	68.77
	Visit No. 6.								
41007	Seconds, 125 pounds	Aug. 10	2,800,000	1,600,000	100,000		.0021	.0067	68.66
41009		Aug. 12	500,000	490,000	10,000		.0018	.0059	69.50
41008	Cracked eggs, 125 pounds	Aug. 13	1,100,000	750,000	10,000		.0021	.0069	69.61
41003	Seconds and cracked eggs, 140 pounds	Aug. 19	3,100,000	1,500,000	10,000		.0024	.0077	68.90
41013	Seconds, 125 pounds	do	800,000	550,000	10,000		.0018	.0062	70.85
41015	Seconds (same lot as No. 41013), 125 pounds	do	460,000	290,000	1,000		.0018	.0059	69.37
41028	Seconds and cracked eggs, 125 pounds	Aug. 21	1,400,000	850,000	100,000		.0019	.0062	69.36
41034	do	do	600,000	440,000	10,000				
41042	Cracked eggs, 125 pounds	Aug. 23	2,900,000	1,700,000	100,000		.0024	.0078	69.10
41045	do	do	2,960,000	1,800,000	100,000		.0022	.0070	68.73

TABLE D–III.—*Commercial samples of whites and yolks—Shell method of separation, 1912.*

Sample No.	Description and size of sample.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.	Ammoniacal nitrogen (Folin method).		Moisture.
			20° C.	37° C.			Wet basis.	Dry basis.	
	Visit No. 1.						*Per cent.*	*Per cent.*	*Per cent.*
4162	Whites, cracked and small eggs, 25 pounds	Apr. 17	100	0	0		0.0002	0.0016	87.90
4163	Yolks of No. 4162	do	50	200	100		.0024	.0054	55.63
4282	Whites, cracked eggs, 25 pounds	May 8	13,500	15,000	1,000	0 in 10,000			
4283	Yolks of No. 4282, 25 pounds	do	25,000	64,000	1,000	0 in 10,000			
	Visit No. 2.								
4407	Whites, seconds, 15 pounds	May 27	1,500,000	700,000	100,000	5,000			
4408	Yolks of No. 4407	do	950,000	490,000	10,000	15,000			
4416	Whites, seconds, 25 pounds	do	60,000	20,000	100				
4417	Yolks of No. 4416	do	15,000	5,000		0 in 1,000			
4423	Whites, seconds, 10 pounds	May 28	1,000	1,000	10	0 in 1,000	.0003	.0023	87.14
4424	Yolks of No. 4423, 25 pounds	do	4,000	2,700	1,000	0 in 1,000	.0030	.0070	57.45
	Visit No. 3.								
4552	Whites, 15 pounds	June 17	430,000	300,000	10,000	30,000	.0002	.0016	87.32
4553	Yolks of No. 4552, 15 pounds	do	500,000	390,000	100,000	130,000	.0025	.0058	56.97
4563	Whites, seconds and cracked eggs, 15 pounds	June 18	97,000	110,000	10	0 in 10,000			
4564	Yolks of No. 4566, 20 pounds	do	87,000	78,000	0	0 in 10,000			
4566	Whites, seconds and cracked eggs, 20 pounds	do	13,500	12,000	1,000	0 in 10,000			
4567	Yolks of No. 4566, 20 pounds	do	15,500	17,500	100	0 in 10,000			
4542	Whites	June 1	600,000	23,000	10,000	0 in 1,000			
4547	Whites, seconds and cracked eggs, 25 pounds	June 6	18,500	15,500	10,000	0 in 1,000			
	Visit No. 4.								
4688	Whites, seconds, 75 pounds	July 9	170,000	21,500	100		.0006	.0046	87.10
4689	Yolks of No. 4689	do	650,000	250,000	1,000		.0031	.0083	62.86
4705	Whites, clean and dirty seconds, 20 pounds	July 10	65,000	22,000			.0005	.0040	87.39
4706	Yolks of No. 4705, 25 pounds	do	63,000	40,000	100		.0029	.0067	56.53
4718	Whites, cracked and dirty eggs, 20 pounds	July 11	160,000	65,000	0				
4719	Yolks of No. 4718	do	650,000	480,000	100				
	Visit No. 5.								
4870	Whites, seconds, 45 pounds	July 30	650,000	550,000	100,000				
4871	Yolks of No. 4870 and other eggs, 125 pounds	do	1,200,000	850,000	1,000,000		.0032	.0079	59.69
4876	Whites, mostly clean seconds, 84 pounds	July 31	370,000	240,000	10,000				
4880	Yolks of No. 4876, 40 pounds	do	1,400,000	1,300,000	100,000		.0025	.0066	62.13
4881	Whites, mostly seconds, 40 pounds	do	250,000	300,000	100				
4882	Yolks of No. 4882, 40 pounds	do	2,100,000	1,600,000	1,000,000				

TABLE D–IV.—*Commercial samples of leaking eggs—Handled by the tray method, 1912.*

(Discussion, p. 11.)

Sample No.	Size of sample.	Date of collection.	Bacteria per gram on plain agar incubated at—		Gas-producing bacteria per gram in lactose bile.	Liquefying organisms per gram.	Ammoniacal nitrogen (Folin method).		Moisture.	Eggs discarded.
			20° C.	37° C.			Wet basis.	Dry basis.		
	Visit No. 3.						*Per cent.*	*Per cent.*	*Per cent.*	
4559	6 dozen	June 17	75,000	59,000	10,000	0 in 10,000	0.0015	0.0053	71.55	.....
4560	4 dozen	...do....	17,500	7,500	1,000	0 in 1,000	.0013	.0047	72.50	.....
4570	3 dozen	June 18	500	0	0	.....	.0016	.0059	72.83	2
4574	.....do	June 19	5,300	2,400	10	.....	.0018	.0064	71.76	4
4584	3½ dozen	June 20	320,000	170,000	10,000	10,000	.0014	.0050	72.06	2
	Visit No. 4.									
4690	4 dozen	July 9	750,000	550,000	100,000	.....	.0015	.0053	71.43	3
4692	3 dozen	...do....	150,000	1,600	10	.....	.....	.....	.....	1
4703	8 dozen	July 10	15,500	7,400	0	.....	.0017	.0059	71.19	4
4707	9 dozen	...do....	2,100,000	1,200,000	100	.....	.0016	.0054	70.53	.....
4709	3 dozen	...do....	1,200	400	0	.....	.0022	.0076	71.07	.....
4713	.....do	July 11	3,700,000	1,400,000	1,000	.....	.....	.....	.....	3
4716	.....do	...do....	54,000	18,500	100	.....	.....	.....	.....	2
	Visit No. 5.									
4867	18 dozen	July 30	230,000	150,000	1,000	.....	.0021	.0068	69.32	18
4874	9 dozen	July 31	370,000	310,000	100,000	.....	.0017	.0059	71.07	8
41010	6 dozen	Aug. 19	140,000	80,000	1,000	.....	.0019	.0058	69.07	7
41030	3 dozen	Aug. 21	37,000	28,000	100	.....	.....	.....	.....	3
41038	6½ dozen	Aug. 22	61,000	31,500	0	.....	.0017	.0059	70.99	6

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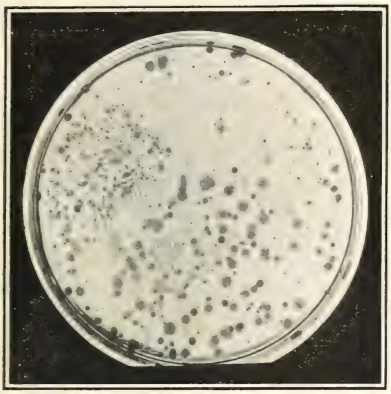


FIG. 1.—ONE DROP OF WATER FROM A SAUCER WASHED IN RUNNING WATER AFTER RECEIVING A BAD EGG. (REPRINT FROM CIRCULAR 98, BUREAU OF CHEMISTRY.)

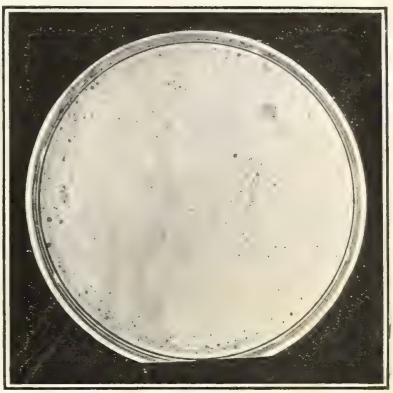


FIG. 2.—ONE DROP OF WATER FROM SAUCER SHELF. (REPRINT FROM CIRCULAR 98, BUREAU OF CHEMISTRY.)

FIG. 3.—ONE DROP OF "DRIP" FROM TRAY (B HOUSE).

FIG. 4.—FINGER TIPS OF BREAKER (B HOUSE).

B HOUSE.

FIG. 1.—EDGE OF WASHED TUMBLER (C HOUSE).

FIG. 2.—FINGER TIPS OF BREAKER (C HOUSE).

FIG. 3.—WASHED FINGER TIPS AFTER CRUSHING TANNERS' EGG.

C HOUSE.

FIG. 1.—ONE DROP OF WATER FROM A WASHED PAIL (E HOUSE).

FIG. 2.—ONE DROP OF WATER FROM A CLEAN PAN (E HOUSE).

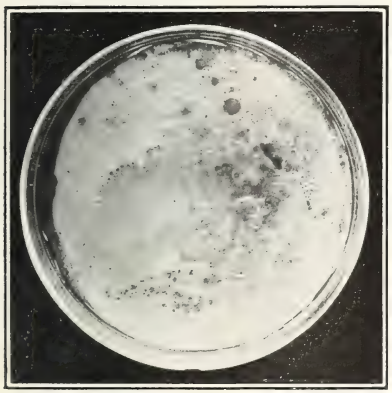


FIG. 3.—ONE DROP OF WATER FROM SINK (E HOUSE).

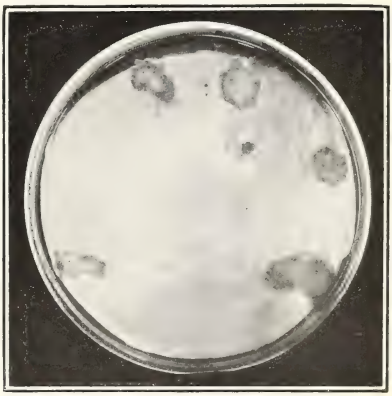


FIG. 4.—FINGER TIPS OF BREAKER (E HOUSE).

E HOUSE.

BREAKING ROOM BEFORE REMODELING (E HOUSE, 1911).

BREAKING ROOM WITH EQUIPMENT AFTER REMODELING (E HOUSE, 1912).

EGG-BREAKING ROOM IN OPERATION AFTER REMODELING (E HOUSE, 1912).

EGG-BREAKING ROOM IN OPERATION (F HOUSE, 1912).

FIG. 1.—EGG-BREAKING EQUIPMENT ON TABLE (F HOUSE, 1912).

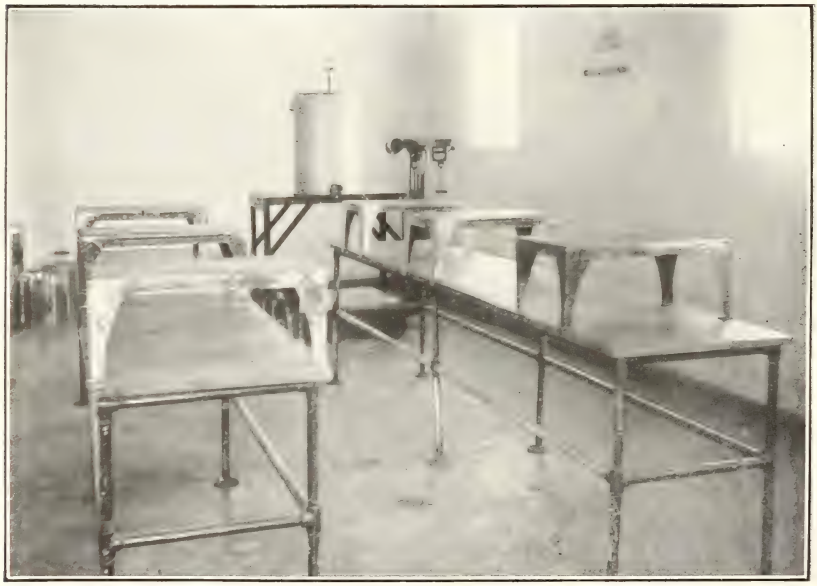


FIG. 2.—VIEW OF EGG-BREAKING ROOM SHOWING TABLES AND CHURN (D HOUSE, 1911 AND 1912).

FIG. 1.—EQUIPMENT USED BY ONE CANDLER (E HOUSE, 1912).

FIG. 2.—OUTFIT USED FOR EGG BREAKING BEFORE REMODELING (E HOUSE, 1911).

FIG. 3.—OUTFIT USED FOR EGG BREAKING AFTER REMODELING (E HOUSE, 1912).

FIG. 1.—OUTFIT USED FOR BREAKING EGGS (F HOUSE, 1912).

FIG. 2.—OUTFIT USED FOR BREAKING EGGS (D HOUSE, 1912).

FIG. 1.—WASHING AND STERILIZING ROOM (E HOUSE, 1912).

FIG. 2.—WINDOW FOR TRANSFERRING APPARATUS BETWEEN BREAKING ROOM AND STERILIZING ROOM (F HOUSE, 1912).

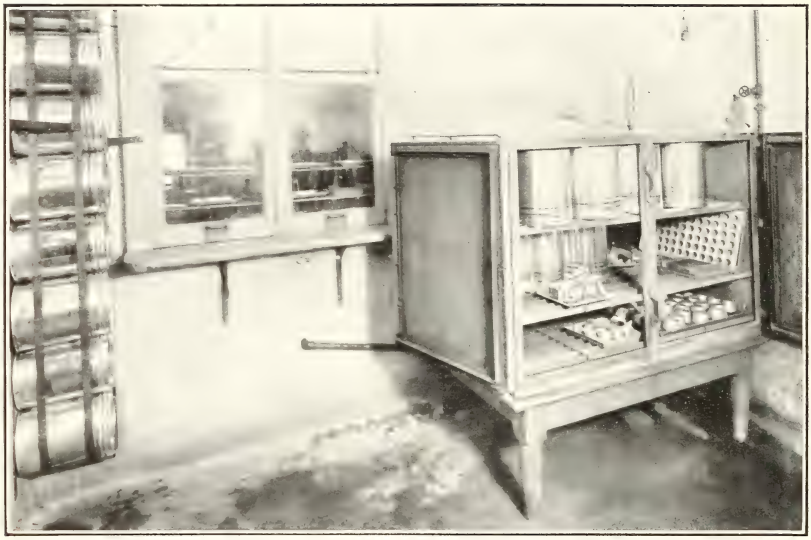


FIG. 1.—VIEW OF STERILIZING ROOM SHOWING STERILIZER, CAN CHUTE, AND WINDOW FOR TRANSFERRING APPARATUS (F HOUSE, 1912).

FIG. 2.—VIEW OF STERILIZING ROOM SHOWING SINK, DRAIN RACK, AND MOTOR-DRIVEN BRUSHES (F HOUSE, 1912).

FIG. 1.—FREEZER FOR CANNED EGGS (D HOUSE, 1912).

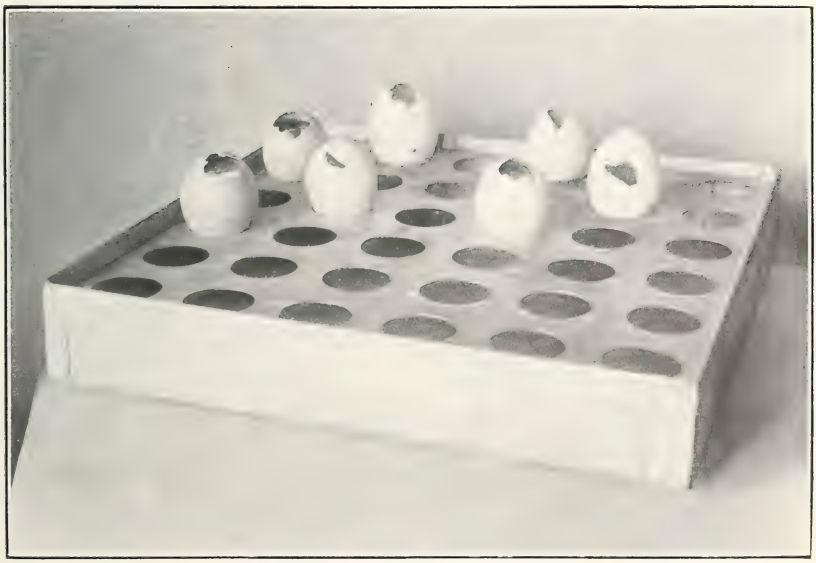


FIG. 2.—TRAY FOR LEAKING EGGS.

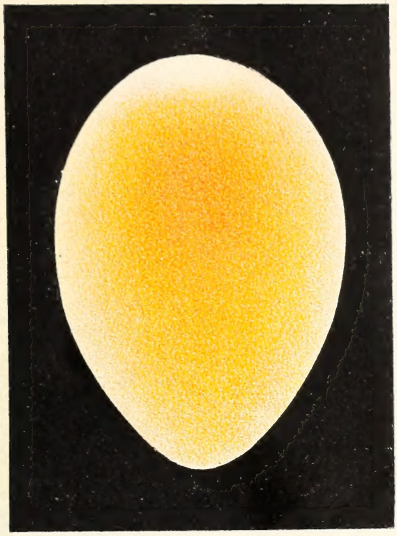
EGG WITH SOFT YOLK BEFORE THE CANDLE AND OUT OF THE SHELL

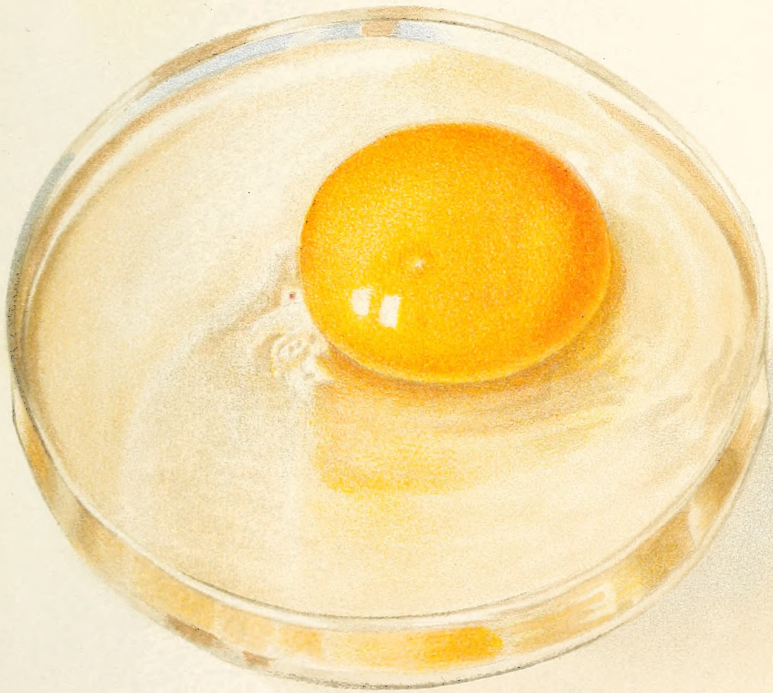
Egg with Yolk Stuck to Shell Before the Candle and Not to the Shell.

H.M.P.Betts

EGG SHOWING MIXED ROT BEFORE THE CANDLE AND OUT OF THE SHELL

BREUKER & KESSLER CO. PHILA.





H.M.P. Betts

A FRESH EGG BEFORE THE CANDLE AND OUT OF THE SHELL

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